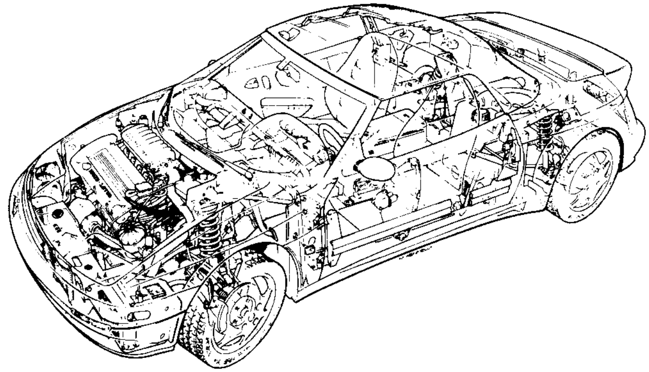
# SERVICE NOTES

# ELAN

## 1990 Model Year Onwards



LOTUS CARS LTD
Norwich, Norfolk, England NR14 8EZ Telephone (0953) 608000
Telefax (0953) 606884 Telex 97401

Part No. A100T0327J

© LOTUS CARS LTD 1989

Publication Part Number A100T0327J Lotus Cars Ltd. November 1989.

This publication has been designed for use by Lotus Dealers familiar with general workshop safety procedures and practices. Take all appropriate action to guard against injury to persons or damage to property.

Lotus policy is one of continuous product improvement, and the right is reserved to alter specifications at any time without notice.

Whilst every care has been taken to ensure correctness of information, it is impossible to guarantee complete freedom from errors or omissions, or to accept liability arising from such errors or omissions, but nothing herein contained shall affect your statutory rights.

**FLUOROELASTOMERS - Cautionary Note** - Issued by the Society of Motor Manufacturers and Traders (SMMT) December 1990.

Fluoroelastomers are synthetic rubbers often used in engines, engine test rigs and other equipment such as 'O' rings and engine gasket seals. When used within designed operating conditions fluoroelastomers are safe and do not present a hazard to health.

If heated beyond normal operating conditions, for example during attempts to remove a tight coupling flange or in a fire, they can break down to give a highly corrosive acid (Hydrofluoric acid) - this can cause serious burns on contact with skin. Avoid skin contact with fire damaged rubbers.

NOTE: Further information and advice is contained in SMMT 'All Members' circular December 1990 entitled "SMMT Guidance on Fluoroelastomers".

MAR 1991

## CONTENTS

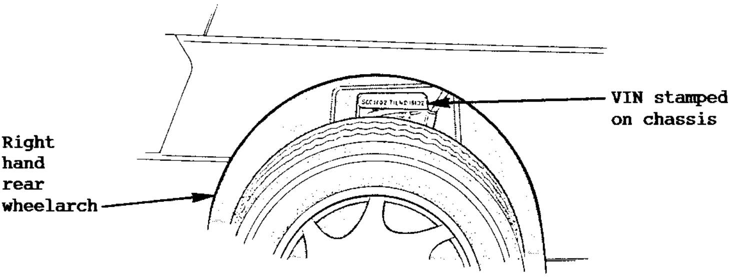
## ELAN SERVICE NOTES MANUAL A100T0327J

| | Section |
|---|---|
| Technical Data - Engine | TDG |
| - Vehicle | TDH |
| Chassis | AD |
| Body - Paint Procedure | BH |
| - Body Repair | BJ |
| - Body Fittings | BK |
| Front Suspension | CE |
| Rear Suspension | DD |
| Engine | EC |
| Engine Management - Catalyst Turbo | EMJ* |
| - Non Catalyst Turbo | EMK* |
| - Naturally Aspirated | EML* |
| * See separate manual B100T0327J (EMJ), C100T0327J (EMK), D100T0327J (EML) | |
| Transmission | FF |
| Wheels & Tyres | GD |
| Steering | HC |
| Brakes | JE |
| Cooling | KD |
| Fuel System | LG |
| Electrics | MJ# |
| # See separate manual F082T0327J (Electrical Sections) | |
| Maintenance & Lubrication | OE |
| Heating, Ventilation & Air Conditioning | PE |
| Clutch | QD |
| Exhaust | SD |
| Interior Trim | VD |
| Supplementary Inflatable Restraint (USA only) | WB** |
| ** See separate manual E100T0327J | |

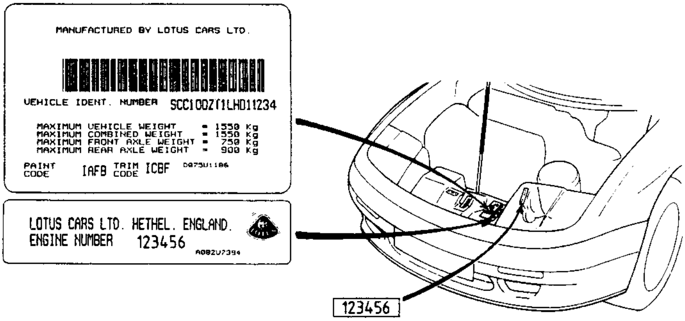
## VEHICLE IDENTIFICATION NUMBER & ENGINE NUMBER

The Vehicle Identification Number (VIN) is stamped on the outboard face of the right hand rear chassis leg, viewable over the right hand rear wheel. The engine number is stamped on the forward facing rear flange of the cylinder block, alongside the clutch housing jointface.

These numbers are duplicated on a pair of bar code labels fixed either at the front of the engine compartment or on the left hand wheelarch. Both the VIN and engine number should be quoted in any enquiries concerning the vehicle.



**Domestic/ Export type**



MANUFACTURED BY LOTUS CARS LTD.

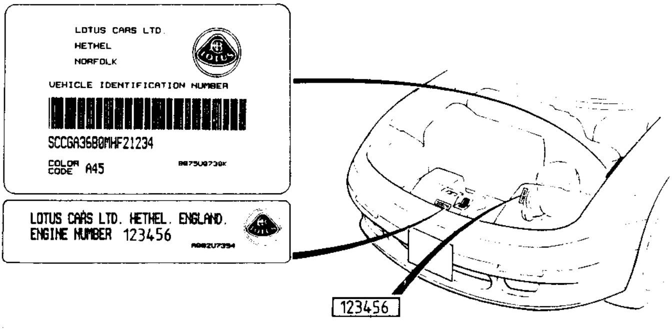
VEHICLE IDENT. NUMBER SCC10DZF1LHD11234

MAXIMUM VEHICLE WEIGHT = 1550 Kg
MAXIMUM COMBINED WEIGHT = 1550 Kg
MAXIMUM FRONT AXLE WEIGHT = 750 Kg
MAXIMUM REAR AXLE WEIGHT = 900 Kg

PAINT CODE IAFB TRIM CODE ICBF D075U1186

LOTUS CARS LTD. HETHEL. ENGLAND.
ENGINE NUMBER 123456
A082U7394

**USA type**



LOTUS CARS LTD.
HETHEL
NORFOLK

VEHICLE IDENTIFICATION NUMBER

SCCGA36B0MHF21234

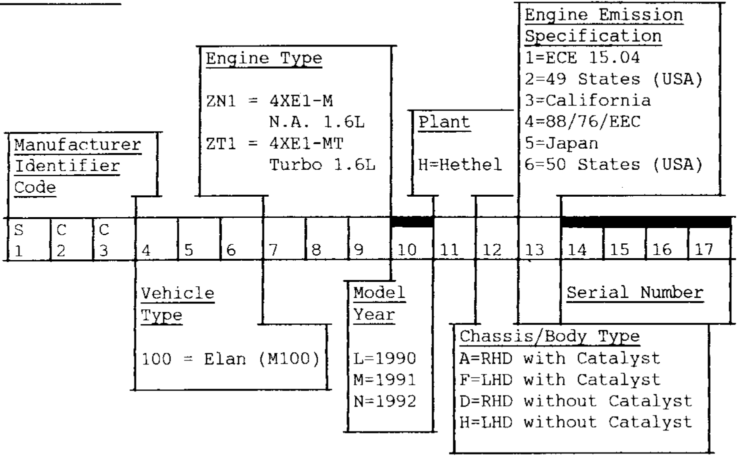
COLOR CODE A45 B075U0730K

LOTUS CARS LTD. HETHEL. ENGLAND.
ENGINE NUMBER 123456
A082U7394

There are two variations of the VIN; one being for Domestic and Export markets other than for the USA, which complies with European Economic Community (EEC) directives; and one for the USA which complies with requirements laid down by the National Highway Traffic Safety Association (NHTSA).

The seventeen characters of the VIN are coded as follows:

DOMESTIC & EXPORT



Manufacturer Identifier Code

Vehicle Type
100 = Elan (M100)

Engine Type
ZN1 = 4XE1-M N.A. 1.6L
ZT1 = 4XE1-MT Turbo 1.6L

Model Year
L=1990
M=1991
N=1992

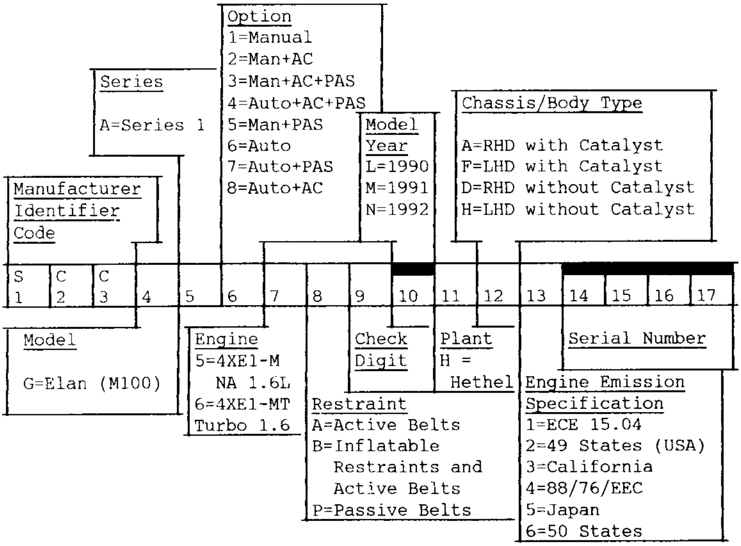
Plant
H=Hethel

Chassis/Body Type
A=RHD with Catalyst
F=LHD with Catalyst
D=RHD without Catalyst
H=LHD without Catalyst

Engine Emission Specification
1=ECE 15.04
2=49 States (USA)
3=California
4=88/76/EEC
5=Japan
6=50 States (USA)

Serial Number

USA



Manufacturer Identifier Code

Model
G=Elan (M100)

Series
A=Series 1

Option
1=Manual
2=Man+AC
3=Man+AC+PAS
4=Auto+AC+PAS
5=Man+PAS
6=Auto
7=Auto+PAS
8=Auto+AC

Engine
5=4XE1-M NA 1.6L
6=4XE1-MT Turbo 1.6

Restraint
A=Active Belts
B=Inflatable Restraints and Active Belts
P=Passive Belts

Check Digit

Model Year
L=1990
M=1991
N=1992

Plant
H = Hethel

Chassis/Body Type
A=RHD with Catalyst
F=LHD with Catalyst
D=RHD without Catalyst
H=LHD without Catalyst

Engine Emission Specification
1=ECE 15.04
2=49 States (USA)
3=California
4=88/76/EEC
5=Japan
6=50 States

Serial Number

V.I.N. Notes

1. Only one serial number sequence is used for all variations of model and market, but the numerical sequence restarts each model year.
2. 1990 Model Year Elan production commenced at VIN serial number 6100. 1991 and subsequent model year serial number sequences start at 6000. VIN serial numbers alone should never be quoted. Either quote the entire seventeen characters, or prefix the serial number with the model year identifier (character 10). e.g. M 6072.
3. For change point identification in Service Notes, Parts Lists and Service Bulletins, only character 10 and the serial number will usually be quoted.

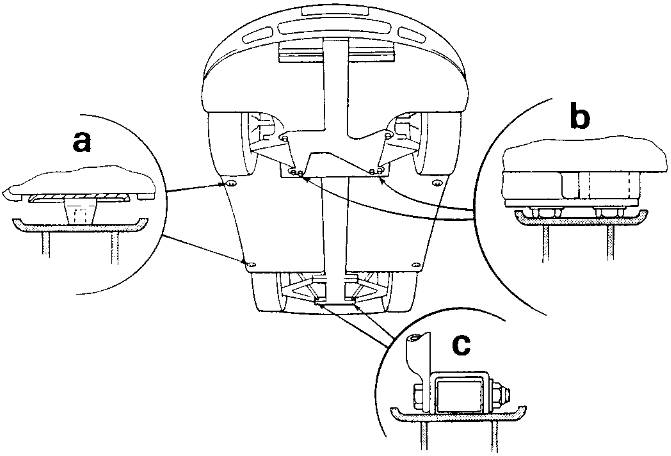
Jacking Points

a) Four body jacking points are provided on the car; one just ahead of each rear wheelarch, and one just behind each front wheelarch. Each body jacking point is fitted with a conical location dowel in order to engage the hole in the vehicle's wheelchanging jack. Other permissible jacking points are:

b) Beneath the bolts securing the rear end of the front suspension rafts to the chassis front crossmember;

c) Beneath the rearmost pivot points of the rear suspension wishbones, bearing on the lower edges of the channel section using a suitable spreader plate.

**CAUTION:** Do NOT use a jack beneath any other part of the vehicle, especially:
- Do **NOT** jack beneath the engine bay underframe;
- Do **NOT** jack beneath the rear suspension lower wishbone. Damage and/or distortion can be caused to either of these components due to incorrect jacking.



Post Accident Inspection

When assessing accident damage/repair, it is most important to include inspection of the following safety systems:
- Collapsible steering column (see section HC.3/WB.3-L);
- Engine mounting collapsible spacers - USA (see section EC.15);
- Supplementary inflatable restraint sensors - USA (see section WB.3-F/G/H);
- Seat belt reel impact absorption mounting - USA (see section VD.11).

## TECHNICAL DATA - ENGINE

## SECTION TDG - ELAN (N.A. & Turbo)

| | Page |
|---|---|
| General Specification | 2 |
| Cylinder Head | 2 |
| Valves | 3 |
| Valve Guides | 3 |
| Valve Seats | 3 |
| Valve Springs | 3 |
| Valve Lifters | 3 |
| Camshafts | 3 |
| Cylinder Block | 4 |
| Pistons & Rings | 4 |
| Connecting Rods | 5 |
| Crankshaft | 5 |
| Flywheel & Ring Gear | 6 |
| Oil Pump | 6 |
| Water Pump | 6 |

## GENERAL

| | |
|---|---|
| Type designation | |
| - Naturally Aspirated (N/A) | 4XE1-M |
| - Turbocharged | 4XE1-MT |
| Engine number location | see introductory pages |
| No. of cylinders | 4 |
| Capacity | 1588 cm$^3$ (96.9 in$^3$) |
| Bore | 80.00 mm (3.145 in) |
| Stroke | 79.00 mm (3.110 in) |
| Compression ratio - N/A | 9.8:1 |
| - Turbo | 8.5:1 |
| Compression pressure @ 300 rpm - N/A | 12.6 bar (185 lb/in$^2$) |
| - Turbo | 11.5 bar (169 lb/in$^2$) |
| Maximum boost pressure (Turbo) | 0.65 bar (9.6 lb/in$^2$) |
| Firing Order | 1,3,4,2 |
| Idle speed - N/A | 900 rpm ) electronically |
| - Turbo | 950 rpm ) controlled |
| Maximum permitted engine speed - N/A | 7,700 rpm |
| - Turbo | 7,200 rpm |
| Belt tension (cold) | |
| - toothed timing belt - new | 7 - 8.5 mm ) one way deflection with |
| - used | 9 - 10.5 mm ) firm finger pressure |
| - alternator | 41 ± 9 kg (90 ± 20 lb) > using Burr- |
| - a/c compressor/PAS | 65 ± 7 kg (145 ± 15 lb) > oughs gauge |
| Fuel injection type | Electronic multi-point |
| Injection timing - N.A. | Simultaneous double fire |
| - Turbo | Semi-sequential double fire |

| | N/A | Turbo | |
|---|---|---|---|
| Valve timing - intake - opens | 7° | 12° | BTDC |
| - closes | 57° | 46° | ABDC |
| - exhaust - opens | 58° | 60° | BBDC |
| - closes | 6° | 2° | ATDC |

| | |
|---|---|
| Turbocharger (Turbo) | IHI model RHB52TW |
| Spark plugs - type - N.A. | NGK BKR6E-11 or ND K20PR-U11 |
| - Turbo - recommended | NGK BKR6E or ND K20PR-U |
| - alternative | NGK BKR7E-11 or ND K22PR-U11 |
| - gap - suffix '11' or 'U11' | 1.1 mm (0.043 in) |
| - others | 0.8 mm (0.031 in) |
| Minimum oil pressure | 0.35 bar @ warm idle |
| Max Power (DIN 70020) - N/A | 97 kW (130 bhp) @ 7,200 rpm |
| - Turbo | 123 kW (165 bhp) @ 6,600 rpm |
| Max Torque (DIN 70020) - N/A | 142 Nm (105 lbf.ft) @ 4,200 rpm |
| - Turbo | 200 Nm (148 lbf.ft) @ 4,200 rpm |

## CYLINDER HEAD

| | |
|---|---|
| Material | Aluminium alloy |
| Head/block jointface flatness | |
| - new | 0.05 mm (0.002 in) max. |
| - service limit | 0.20 mm (0.008 in) |
| - max. repairable limit | 0.40 mm (0.016 in) |
| - min. usable head height | 129.90 mm (5.114 in) |
| Head/manifold jointface flatness | |
| - new | 0.05 mm (0.002 in) max. |
| - service limit | 0.40 mm (0.016 in) |

## VALVES

| | |
|---|---|
| Valve clearance | zero (hydraulically controlled) |
| Angle of valve seats & faces | 45° |
| Head diameter - inlet | 31 mm (1.22 in) |
| - exhaust | 28 mm (1.10 in) |
| Stem diameter - inlet - new | 5.957 - 5.977 mm (0.2345 - 0.2353 in) |
| - service limit | 5.900 mm (0.2323 in) |
| - exhaust - new | 5.952 - 5.970 mm (0.2343 - 0.2350 in) |
| - service limit | 5.900 mm (0.2323 in) |
| Valve head edge thickness | 0.800 mm (0.0315 in) minimum |

## VALVE GUIDES

| | |
|---|---|
| Valve/guide clearance | |
| - inlet - new | 0.023 - 0.056 mm (0.0009 - 0.0022 in) |
| - service limit | 0.020 mm (0.0079 in) |
| - exhaust - new | 0.030 - 0.063 mm (0.0012 - 0.0025 in) |
| - service limit | 0.020 mm (0.0079 in) |
| Valve guide standout above head - inlet | 15.0 mm (0.59 in) |
| - exhaust | 15.5 mm (0.61 in) |

## VALVE SEATS

| | |
|---|---|
| Valve seat recession: standout of NEW valve above combustion chamber surface - new | 1.10 mm (0.043 in) nominal |
| - service limit | 0.60 mm (0.024 in) |
| Contact width - inlet - new | 1.5 mm (0.06 in) |
| - service limit | 2.2 mm (0.09 in) |
| - exhaust - new | 1.3 mm (0.05 in) |
| - service limit | 2.0 mm (0.08 in) |
| Interference fit | 0.08 - 0.15 mm (0.003 - 0.006 in) |

## VALVE SPRINGS

| | |
|---|---|
| Free length - new | 44.7 mm (1.76 in) |
| - service limit | 43.2 mm (1.70 in) |
| Squareness - service limit | 1.0 mm (0.04 in) |
| Tension at installed height (38.2 mm) | 19.6 N (44.1 lbf) |

## VALVE LIFTERS

| | |
|---|---|
| Outside diameter - new | 38.00 mm (1.496 in) nominal |
| - service limit | 37.95 mm (1.494 in) |
| Lifter/head clearance - new | 0.01 - 0.04 mm (0.004 - 0.016 in) |
| - service limit | 0.20 mm (0.079 in) |

## CAMSHAFTS

| | |
|---|---|
| Valve lift - inlet & exhaust | 8.4 mm (0.33 in) |
| Minimum cam lobe height - inlet & exhaust | 39.02 mm (1.536 in) |
| Lobe uneven wear limit | 0.05 mm (0.002 in) |
| Journal diameter - new | 25.94 - 25.96 mm (1.021 - 1.022 in) |
| - service limit | 25.80 mm (1.016 in) |
| Journal uneven wear limit | 0.05 mm (0.002 in) |
| Maximum run-out | 0.10 mm (0.004 in) |

| | |
|---|---|
| Oil clearance (measured using Plastigage) | |
| - new | 0.060 - 0.110 mm (0.0024 - 0.0044 in) |
| - service limit | 0.150 mm (0.059 in) |
| End float - new | 0.05 0.15 mm (0.002 - 0.006 in) |
| - service limit | 0.20 mm (0.008 in) |
| Distributor drive slot width | 5.00 mm (0.196 in) maximum |

CYLINDER BLOCK

| | |
|---|---|
| Material | Cast iron |
| Block/head jointface flatness | |
| - service limit | 0.20 mm (0.008 in) |
| - max. repairable limit | 0.40 mm (0.016 in) |
| - min. usable block height | 245.60 mm (9.669 in) |
| Bore diameter - standard - new - grade A | 80.000 - 80.010 mm (3.1496 - 3.1500 in) |
| - grade B | 80.011 - 80.020 mm (3.1500 - 3.1504 in) |
| - grade C | 80.021 - 80.030 mm (3.1504 - 3.1508 in) |
| - service limit* | 80.200 mm (3.1575 in) |
| - + 0.50 mm - new | To be calculated (see section EC.11) |
| - service limit* | 80.700 mm (3.1772 in) |
| - + 1.00mm - new | To be calculated (see section EC.11) |
| - service limit* | 81.200 mm (3.1970 in) |

* largest of 3 measurements at 12, 55 & 95 mm down from deck face.

PISTONS & RINGS

| | |
|---|---|
| Type | Solid skirt |
| Material | Cast aluminium alloy |
| Rings | 2 compression, 1 oil control |

Diameter (@ 90° to pin axis, 30 mm down from crown) - **N/A**

| | |
|---|---|
| - standard - new - grade A | 79.942 - 79.952 mm (3.1473 - 3.1477 in) |
| - grade B | 79.953 - 79.962 mm (3.1477 - 3.1481 in) |
| - grade C | 79.963 - 79.972 mm (3.1481 - 3.1484 in) |
| - + 0.50 mm - new | 80.445 - 80.465 mm (3.1671 - 3.1679 in) |
| - + 1.00 mm - new | 80.945 - 80.965 mm (3.1868 - 3.1875 in) |

Diameter (@ 90° to pin axis, 30 mm down from crown) - **Turbo**

| | |
|---|---|
| - standard - new - grade A | 79.932 - 79.942 mm (3.1469 - 3.1473 in) |
| - grade B | 79.943 - 79.952 mm (3.1474 - 3.1477 in) |
| - grade C | 79.953 - 79.962 mm (3.1477 - 3.1481 in) |
| - + 0.50 mm - new | 80.435 - 80.455 mm (3.1667 - 3.1675 in) |
| - + 1.00 mm - new | 80.935 - 80.955 mm (3.1864 - 3.1872 in) |
| Piston/bore clearance - N/A | 0.048 - 0.068 mm (0.0019 - 0.0027 in) |
| - Turbo | 0.058 - 0.078 mm (0.0023 - 0.0031 in) |

Piston ring identification on top surface:

| Piston ring | Standard | + 0.50 mm | + 1.00 mm |
|---|---|---|---|
| 1st Compression | - | 50 | 100 |
| 2nd Compression | - | 50 | 100 |
| Oil Control | red | blue | yellow |

| | |
|---|---|
| Piston ring end gap (at smallest bore position) | |
| - new - 1st compression | 0.28 - 0.40 mm (0.011 - 0.016 in) |
| - 2nd compression | 0.45 - 0.60 mm (0.018 - 0.024 in) |
| - oil control | 0.10 - 0.60 mm (0.004 - 0.024 in) |
| Ring/piston clearance | |
| - 1st compression - new | 0.025 - 0.065 mm (0.0010 - 0.0025 in) |
| - service limit | 0.150 mm (0.0060 in) |
| - 2nd compression - new | 0.020 - 0.060 mm (0.0008 - 0.0024 in) |
| - service limit | 0.150 mm (0.0060 in) |
| Gudgeon pin diameter - new - N/A | 18.000 mm (0.7087 in) |
| - Turbo | 20.000 mm (0.7874 in) |
| - service limit - N/A | 17.970 mm (0.7075 in) |
| - Turbo | 19.970 mm (0.7862 in) |
| Gudgeon pin clearance in piston | |
| - new - N/A | 0.012 - 0.017 mm (0.0005 - 0.0007 in) |
| - Turbo | 0.007 - 0.017 mm (0.0003 - 0.0007 in) |
| - service limit | 0.040 mm (0.0016 in) |

CONNECTING RODS

| | |
|---|---|
| Maximum bend per 100 mm (3.9 in) | 0.15 mm (0.006 in) |
| Maximum twist per 100 mm (3.9 in) | 0.20 mm (0.008 in) |
| Small end/gudgeon fit | |
| - N/A interference | 0.020 - 0.041 mm (0.0008 - 0.0016 in) |
| - Turbo clearance - new | 0.008 - 0.017 mm (0.0003 - 0.0007 in) |
| - service limit | 0.040 mm (0.0016 in) |
| Big end side clearance - new | 0.20 - 0.35 mm (0.008 - 0.014 in) |
| - service limit | 0.40 mm (0.016 in) |
| Big end oil clearance plastigage width | |
| - new | 0.025 - 0.058 mm (0.0010 - 0.0023 in) |
| - service limit | 0.120 mm (0.0047 in) |
| Max weight variation piston/con rod assy. | 10 g (0.35 oz) |

CRANKSHAFT

Big end bearing shell selection: (all dimensions in mm)

| Marking on connecting rod | Diameter of big end bearing in connecting rod | Crank pin diameter | Bearing colour code | Bearing shell thickness (reference) |
|---|---|---|---|---|
| 1 | 42.994 - 43.000 | 39.935 - 39.950 | blue | 1.503 - 1.507 |
| 11 | 42.988 - 42.993 | | black | 1.499 - 1.503 |
| 111 | 42.982 - 42.987 | | brown | 1.495 - 1.499 |

| | |
|---|---|
| Main bearing oil clearance Plastigage width | |
| - new | 0.020 - 0.048 mm (0.0008 - 0.0020 in) |
| - service limit | 0.120 mm (0.0047 in) |
| Thrust clearance - new | 0.06 - 0.24 mm (0.002 - 0.010 in) |
| - service limit | 0.030 mm (0.012 in) |
| Main bearing shells - type - upper | groove & hole (2 holes on Turbo) |
| - lower | plain |

Main bearing shell selection: (all dimensions in mm)

| Marking on cylinder block | Diameter of main bearing bore in block | Crankshaft main journal diameter | size mark on crank web | bearing colour code |
|---|---|---|---|---|
| 1 | 55.992 - 56.000 | 51.918 - 51.928 | - - | blue |
| | | 51.929 - 51.938 | - | black |
| 2 | 55.984 - 55.991 | 51.918 - 51.928 | - - | |
| | | 51.929 - 51.938 | - | brown |
| 3 | 55.976 - 55.983 | 51.918 - 51.928 | - - | |
| | | 51.929 - 51.938 | - | green |

FLYWHEEL & RING GEAR

| | |
|---|---|
| Run-out at ring gear | 0.10 mm (0.004 in) max. |

OIL PUMP

| | |
|---|---|
| Type | Trochoidal rotor/annulus |
| Delivery | 34 l/min @ 5,200 pump rpm, 3.5 kg/cm$^2$ |
| Relief valve opening pressure | 5.0 kg/cm$^2$ (71 lb/in$^2$) |
| Annulus to housing clearance | |
| - new | 0.10 - 0.18 mm (0.004 - 0.007 in) |
| - service limit | 0.20 mm (0.008 in) |
| Tip to tip clearance - new | 0.06 - 0.22 mm (0.002 - 0.009 in) |
| - service limit | 0.30 mm (0.012 in) |
| Rotor & annulus side clearance | |
| - new | 0.025 - 0.075 mm (0.0010 - 0.0030 in) |
| - service limit | 0.100 mm (0.0039 in) |

WATER PUMP

| | |
|---|---|
| Type | Centrifugal impellor |
| Drive | Via toothed cam belt |
| Delivery | 150 l/min @ 5,000 pump rpm, 80°C |
| Thermostat | Wax pellet type with jiggle valve |

# TECHNICAL DATA - VEHICLE

## SECTION TDH - ELAN (N.A. & Turbo)

| | Page |
|---|---|
| Dimensions | 2 |
| Capacities | 2 |
| Front Suspension | 2 |
| Rear Suspension | 3 |
| Steering | 3 |
| Wheels | 3 |
| Tyres | 3 |
| Brakes | 4 |
| Transmission | 4 |
| Clutch | 4 |
| Engine Cooling | 5 |
| Electrical Equipment | 5 |
| Fuel Consumption | 6 |
| Torque Settings | 6 |

## DIMENSIONS

| | |
|---|---|
| Overall length - Dom/Exp | 3803 mm (149.7 in) |
| - USA | 3872 mm (152.4 in) |
| Overall width - excl. mirrors | 1734 mm (68.3 in) |
| - inc. mirrors | 1885 mm (74.3 in) |
| Overall height (soft top raised) | 1230 mm (48.4 in) |
| Wheelbase | 2250 mm (88.6 in) |
| Track - front | 1486 mm (58.5 in) |
| - rear | 1486 mm (58.5 in) |
| Ground clearance | 130 mm (5.1 in) |
| Turning circle - between kerbs | 10.66 m (35 ft) |
| Kerb weight - N.A. - total | 1032 kg (2276 lb) inc. full fuel tank |
| - front axle (65%) | 673 kg (1484 lb) |
| - rear axle (35%) | 359 kg (792 lb) |
| - Turbo - Dom/Exp - total | 1085 kg (2392 lb) |
| - front axle (66%) | 718 kg (1583 lb) |
| - rear axle (34%) | 367 kg (809 lb) |
| - USA - total | 1112 kg (2451 lb) |
| - front axle (67%) | 746 kg (1644 lb) |
| - rear axle (33%) | 366 kg (807 lb) |
| Gross weight - N.A. - total | 1250 kg (2756 lb) inc. occupants & luggage |
| - front axle (60%) | 750 kg (1654 lb) |
| - rear axle (40%) | 500 kg (1103 lb) |
| - Turbo - Dom/Exp - total | 1270 kg (2800 lb) |
| - front axle (60%) | 768 kg (1693 lb) |
| - rear axle (40%) | 502 kg (1107 lb) |
| - USA - total | 1302 kg (2870 lb) |
| - front axle (62%) | 805 kg (1774 lb) |
| - rear axle (38%) | 497 kg (1096 lb) |
| Drag coefficient - roof raised | 0.34 |
| - roof down | 0.38 |

## CAPACITIES

| | |
|---|---|
| Engine - refill - inc. filter | 3.5 litre (6.2 imp pt; 3.7 US qt) |
| - without filter | 3.3 litre (5.8 imp pt; 3.5 US qt) |
| - dry | 4.75 litre (8.4 imp pt; 5.0 US qt) |
| Difference between high/low dipstick marks | 1.1 litre (1.9 imp pt; 1.2 US qt) |
| Transmission - dry | 1.9 litre (3.35 imp pt; 2.0 US qt) |
| - refill | 1.8 litre (3.2 imp.pt; 1.9 US qt) |
| Cooling system | 6.25 litre (11 imp pt; 6.6 US qt) |
| Fuel tank | 46 litre (10.2 imp gall; 12.3 US gall) |
| Luggage boot | 185 litre (6.5 cu.ft) |

## FRONT SUSPENSION

| | |
|---|---|
| Type | Independent. Unequal length upper & lower wishbones, coaxial coil springs and dampers acting on lower wishbone, tubular anti-roll bar. Seperate aluminium alloy subframes. |

| | |
|---|---|
| Ride height for geometry check | 165 mm to lower wishbone inboard pivot |
| Camber | - 0.25°; ± 0.25° |
| Castor | + 1°; + 0.5°, - 0 |
| Steering axis inclination | 10.5° |
| Scrub radius | - 3 mm |
| Toe-out | 0° to 0.25° total |

REAR SUSPENSION

| | |
|---|---|
| Type | Indepenent. Wide based lower wishbone, single top link, coaxial coil spring & damper acting on lower wishbone, anti-roll bar, rising rate bump rubbers. |
| Ride height for geometry check | 154 mm to extreme rear edge of chassis |
| Camber | - 0.5°; ± 0.25° |
| Toe-in | + 1.5 to + 2.0 mm **each side** |

STEERING

| | |
|---|---|
| Steering wheel diameter | 365 mm (14.4 in) |
| Type | Manual or power assisted rack and pinion |
| Column - non S.I.R. | Energy absorbing collapsible, adjustable for height. |
| - S.I.R. | Energy absorbing collapsible, air bag incorporated into steering wheel hub. |
| Turns, lock to lock - manual | 2.96 |
| - power | 2.74 |
| Ratio - manual | 42.6 mm per steering wheel turn |
| - power | 46.1 mm per steering wheel turn |
| PAS pump belt tension | 65 ± 7 kgf (145 ± 15 lbf)<br>using a Burroughs gauge |

WHEELS

| | |
|---|---|
| Type - standard | Light alloy, 4 bolt fixing |
| - for winter tyre | Steel, 4 bolt fixing |
| - temporary spare | 'Compact' steel, 4 bolt fixing |
| Size - standard alloy - 15in | 6½J x 15 H2E 60 |
| - 16in | 7J x 16 H2 ET 60 |
| - winter steel | 6J x 14 |
| - temporary spare | 3½J x 14 H2 |
| Inset - standard alloy | + 60 mm |
| Wheel bolt torque* | 80 - 88 Nm (59 - 65 lbf.ft) |

(* note that the wheel bolts for the winter steel wheels, are shorter than those for the standard alloy wheels. Torque remains unchanged.)

TYRES

| | |
|---|---|
| Type - standard - N.A. | Michelin MXV-2 |
| - Turbo - 15in | Michelin MXX-2 |
| - 16in | Goodyear Eagle GS-D |
| - winter tyre* (not USA) | Michelin X M+S with or without studs |

* for limitations on use of winter tyres, see section GD.

| | | |
|---|---|---|
| - temporary spare | Goodyear space saver or Michelin Tex | |
| Size - standard - N.A. | 205/50 VR15 | |
| - Turbo - 15in | 205/50 ZR15 | |
| - 16in | 205/45 ZR16 | |
| - winter tyre | 185/60 x 14 | |
| - temporary spare | T105/70 R14 | |
| Pressures (front & rear) | | |
| - standard - N.A. | 2.2 bar (32 lb/in$^2$) | > all pressures |
| - Turbo - 15in | 1.8 bar (26.5 lb/in$^2$) | > are with |
| - 16in | 1.8 bar (26.5 lb/in$^2$)* | > tyres fully |
| - winter tyre | 2.0 bar (29 lb/in$^2$) | > cold |
| - temporary spare | 4.0 bar (60 lb/in$^2$) | > |

* For continuous speeds over 100 mph (160 km/h) increase pressures to 2.0 bar (29.5 lb/in$^2$)

## BRAKES

| | | |
|---|---|---|
| Type | | Ventilated front discs, solid rear discs with single piston sliding calipers |
| Operation | | 22.2 mm bore tandem master cylinder with direct acting 200 mm vacuum servo |
| Circuit | | Diagonal split. Pressure proportioning valve in each rear circuit |
| Parking brake | | Cable operation of rear calipers |
| Brake discs | | |
| - diameter | - front | 256 mm |
| | - rear | 236 mm |
| - thickness - nominal | - front | 24.0 mm |
| | - rear | 12.65 mm |
| - minimum | - front | 22.0 mm |
| | - rear | 10.9 mm |
| - maximum runout - fitted | | 0.10 mm |
| - actual | | 0.03 mm |
| Brake pads - material | | Ferodo 3432 |
| - standard thickness | - front | 15.5 mm (0.60 in) |
| | - rear | 14.5 mm (0.57 in) |
| - minimum thickness | - front | 2.0 mm (0.08 in) |
| | - rear | 1.0 mm (0.04 in) |
| Proportioning/limiting valves | | see section JE |

## TRANSMISSION

Type Manual, 5 speed + reverse

| Gear | Internal Ratio | Final Drive | | mph/1000 rpm | | | km/h/1000 rpm | | |
|---|---|---|---|---|---|---|---|---|---|
| | | N.A. | Turbo | N.A. | Turbo | | N.A. | Turbo | |
| | | | | | 15in | 16in | | 15in | 16in |
| First | 3.333:1 | 4.117 | 3.833 | 4.84 | 5.20 | 5.22 | 7.78 | 8.35 | 8.40 |
| Second | 1.916:1 | " | " | 8.41 | 9.04 | 9.08 | 13.5 | 14.5 | 14.6 |
| Third | 1.333:1 | " | " | 12.1 | 13.0 | 13.0 | 19.5 | 20.9 | 20.9 |
| Fourth | 1.027:1 | " | " | 15.7 | 16.9 | 16.9 | 25.3 | 27.2 | 27.2 |
| Fifth | 0.829:1 | " | " | 19.4 | 20.9 | 21.0 | 31.3 | 33.6 | 33.8 |
| Rev | 3.583:1 | " | " | 4.50 | 4.85 | 4.85 | 7.24 | 7.78 | 7.78 |

| | |
|---|---|
| Drive shafts | Equal length with inboard & outboard constant velocity joints |
| C.V. joints - inboard | Plunging tripod type |
| - outboard | 6 ball Birfield type |

## CLUTCH

| | |
|---|---|
| Type | Single dry plate. Asbestos free |
| Release | Cable operated ball type release bearing |
| Driven plate o/d - N.A. | 215 mm |
| - Turbo | 225 mm |
| Pressure plate clamp load - N.A. | 440 kgf |
| - Turbo | 500 kgf |

## ENGINE COOLING

| | |
|---|---|
| Type | Closed water circuit. Engine driven centrifugal pump. Thermostat controlled radiator circuit. 2 electric fans with thermal switch. Auxiliary electric pump on Turbo models with ign. off thermal control. |
| Header tank pressure cap | 110 kPa (15 lb/in$^2$) |
| Anti-freeze/corrosion inhibitor | recommended 40% concentration<br>minimum 25% year round<br>maximum 60% in severe climates |

## ELECTRICAL EQUIPMENT

| | |
|---|---|
| Voltage polarity | 12V negative earth |
| Battery - type | Delco Freedom maintenance free model 842 |
| - amp hour | 55 amp hr @ 20 hr rating |
| - cold start performance (DIN) | 255A |
| - Euro-standard size code | L2 |
| Alternator - make | Nippondenso |
| - rated output | 60 A |
| - regulated voltage | 14.2 to 14.8 V |
| - drive belt tension | 41 ± 10 kgf (90 ± 20 lbf) using a Burroughs gauge |
| Starter motor - type | Nippondenso pre-engaged |
| - rated output | 1.2 Kw |
| Inertia switch | 7g |
| Wiper system | Mechanical linkage, 2 x 585 mm blades |

| **Light Bulbs** | **European** | **USA** | **Wattage** | **Replacement Bulb Number** | **Type** |
|---|---|---|---|---|---|
| Headlamps - outer | * | | 55 | 448 | H1 |
| - inner - Cibie | * | | 55 | 448 | H1 |
| - inner - Carello | * | | 60 | 472 | H4 |
| France - outer | * yellow lens | | 55 | 448 | H1 |
| - inner | * yellow lens | | 55 | 448 | H1 |
| Japan - outer | | | 55 | 472 | H4 |
| - inner | | | 60 | 472 | H4 |
| USA - outer | | * | 37.5 | | Sealed beam |
| - inner | | * | 60 | | Sealed beam |
| Front side/parking lamps | * | * | 5 | 501 | W10/5 |
| Front sidemarker lamps | | * | 5 | 501 | W10/5 |
| Front turn indicator lamps | * | * | 21 | 382/1156 | P25-1 |
| Side repeater lamps | * | | 5 | 501 | W10/5 |
| Tail lamps | * | | 5 | 207 | R19/5 |
| Rear turn | * | | 21 | 382 | P25-1 |
| Stop lamps | * | * | 21 | 382/1156 | P25-1 |
| Tail/turn | | * | 21/5 | 380/1157 | P21/5W |
| High mounted stop lamp | | * | | 891 | |
| Rear fog lamps | * | | 55 | 453 | H3 |
| Reversing lamps | * | * | 21 | 382/1156 | P25-1 |
| Rear sidemarker lamps | | * | 5 | 501 | W10/5 |
| Interior lamps | * | * | 5 | 501 | W10/5 |
| Boot lamp | * | * | 10 | 258 | SU8.5-8 |

FUEL CONSUMPTION - United Kingdom DoE

| | Nat. Asp | | Turbocharged | | | |
|---|---|---|---|---|---|---|
| | | | Without catalyst | | With catalyst | |
| Test | Imp. mpg | 1/100 km | Imp. mpg | 1/100 km | Imp. mpg | 1/100 km |
| Urban cycle | 25.9 | 10.9 | 26.2 | 10.8 | 26.4 | 10.7 |
| Constant 56 mph (90 km/h) | 40.8 | 6.9 | 42.2 | 6.7 | 40.6 | 7.0 |
| Constant 75 mph(120 km/h) | 35.2 | 8.0 | 31.8 | 8.9 | 31.7 | 8.9 |

TORQUE SETTINGS

| **Chassis** | **Nm** | **lbf.ft** |
|---|---|---|
| Underframe to chassis | 75 | 55 |
| Underframe to support stay | 75 | 55 |
| Support stay to chassis | 75 | 55 |
| Longeron to chassis | 120 | 89 |
| Dom/Exp: | | |
| Front frame to longeron | 22 | 16 |
| Radiator support frame to front frame | 10 | 7.5 |
| Radiator frame 'Y' brackets, top | 10 | 7.5 |

**Torque settings contd.**

| | Nm | lbf.ft |
|---|---|---|
| Radiator frame 'Y' brackets, bottom | 22 | 16 |
| Radiator frame front strut (towing eye), top | 10 | 7.5 |
| Radiator frame front strut (towing eye), bottom | 22 | 16 |
| Radiator frame to underframe | 10 | 7.5 |
| USA: | | |
| Transverse beam to longeron | 70 - 75 | 52 - 55 |
| Crash snubber bracket to transverse beam | 68 - 70 | 50 - 52 |

**Body**

| | | |
|---|---|---|
| Rear bumper to body | 16 - 20 | 12 - 15 |
| Body to chassis | 49 | 36 |

**Front Suspension**

| | | |
|---|---|---|
| Damper top stem nut | 20 - 30 | 15 - 22 |
| Top wishbone inboard pivot | 55 - 58 | 41 - 43 |
| Raft top mounting bolt | 75 - 80 | 55 - 59 |
| Sandwich plate to raft | 22 - 25 | 16 - 18 |
| Top wishbone to ball joint | 22 - 25 | 16 - 18 |
| Lower wishbone inboard pivot bolt | 68 - 72 | 50 - 53 |
| Lower wishbone inboard pivot end plate | 22 - 25 | 16 - 18 |
| Lower wishbone strut to main member | 41 - 45 | 30 - 33 |
| Suspension strut yoke to lower wishbone | 105 - 110 | 77 - 81 |
| Ball joint to anti-roll bar | 25 - 27 | 18 - 20 |
| Yoke to suspension unit | 35 - 38 | 26 - 28 |
| Lower swivel joint to hub carrier | 61 - 67 | 45 - 49 |
| Top swivel joint to hub carrier | 61 - 67 | 45 - 49 |
| Raft front and rear mounting bolts | 75 - 80 | 55 - 59 |
| Spring top seat to chassis | 22 - 25 | 16 - 18 |
| Track rod end to steering arm | 58 - 64 | 43 - 47 |
| Driveshaft to front hub | 225 - 235 | 166 - 173 |

**Rear Suspension**

| | | |
|---|---|---|
| Damper top stem nut | 20 - 30 | 15 - 22 |
| Spring top seat to chassis | 22 - 25 | 16 - 18 |
| Damper to lower wishbone* | 68 - 72 | 50 - 53 |
| Top link, outboard* and inboard** | 75 - 80 | 55 - 59 |
| Top link camber adjustment bolts | 22 - 25 | 16 - 18 |
| Lower wishbone inboard pivot (to chassis)* | 65 - 70 | 48 - 52 |
| Lower wishbone outboard pivot (to hub carrier)* | 95 - 100 | 70 - 74 |
| Anti-roll bar to wishbone ball joint | 36 - 40 | 27 - 30 |
| Anti roll bar ball joints to lower wishbone | 36 - 40 | 27 - 30 |
| Anti-roll bar drop links | 36 - 40 | 27 - 30 |
| Hub nut | see section DD.6 | |
| Stub axle to hub carrier** | 60 - 65 | 44 - 48 |
| Brake caliper bracket to hub carrier** | 35 - 39 | 26 - 29 |
| Brake caliper to mounting bracket | 100 - 110 | 74 - 81 |

* Tighten only at ride height.
** Apply thread locking compound unless renewing bolts (pre-applied).

**Transmission**

| | | |
|---|---|---|
| Speedo drive retaining plate | 6 | 4.5 |
| Drain plug | 39 | 29 |
| Gearlever base unit to mounting bracket | 15 | 11 |

**Torque settings contd.**

| | Nm | lbf.ft |
|---|---|---|
| Gearlever mounting bracket screws | 22.5 | 17 |
| Clutch housing to cylinder block | 90 | 66 |
| Jackshaft bearing bracket to block | 38 | 28 |
| Bearing retainer plate | 19 | 14 |
| Interlock plunger retaining plate | 19 | 14 |
| Gearbox casing to clutch housing | 37 | 27 |
| Reverse idler shaft retaining bolt | 37 | 27 |
| Selector detent plugs | 25 | 19 |
| 5th speed drive & driven gear nuts | 127 | 94 |
| Gear selector housing | 19 | 14 |
| End cover | 19 | 14 |
| Crown wheel to carrier | 113 | 83 |
| **Wheels** | | |
| Wheel bolts | 80 - 88 | 59 - 65 |
| **Steering** | | |
| Rack housing to chassis | 120 | 89 |
| High pressure pipe from pump to pinion housing | 19 - 23 | 14 - 17 |
| Low pressure pipe from pinion housing | 19 - 23 | 14 - 17 |
| Pipe connections, pinion housing to rack tube | 12 | 9 |
| Outer column to pedal box | 10 | 7.5 |
| Column to scuttle beam | 15 | 11 |
| Upper u/j to intermediate shaft | 40 | 30 |
| Lower u/j to pinion shaft | 25 | 18 |
| Steering wheel to column | 40 | 30 |
| Track rod end locknut | 60 | 44 |
| Track rod end to steering arm | 58 - 64 | 43 - 47 |
| Track rod ball joint to steering rack | 72.5 | 54 |
| PAS pump pivot & strap bolts | 18 | 13 |
| **Brakes** | | |
| Front caliper mounting bolts | 85 - 110 | 63 - 81 |
| Rear caliper mounting bolts | 90 - 110 | 66 - 81 |
| Brake hose to caliper | 40 | 30 |
| Bleed nipple | 9 - 16 | 7 - 12 |
| Parking brake cable abutment to caliper | 33 - 52 | 24 - 38 |
| Servo to pedal box | 16 - 20 | 12 - 15 |
| Pedal box to bulkhead | 22 | 16 |
| Pedal box brace to scuttle beam | 25 | 19 |
| Master cylinder to servo | 15 - 18 | 11 - 13 |
| Brake pipe tube nuts, M10 & M12 | 15 | 11 |
| **Cooling System** | | |
| Oil cooler banjo bolts | 33 | 24 |
| **Fuel System** | | |
| Tank strap bolts | 12 | 9 |
| Fuel filter connections | 27 | 20 |
| **Air Conditioning** | | |
| Evaporator inlet connection | 11 - 16 | 8 - 12 |
| Evaporator outlet connection | 18 - 23 | 13 - 17 |

**Torque settings contd.**

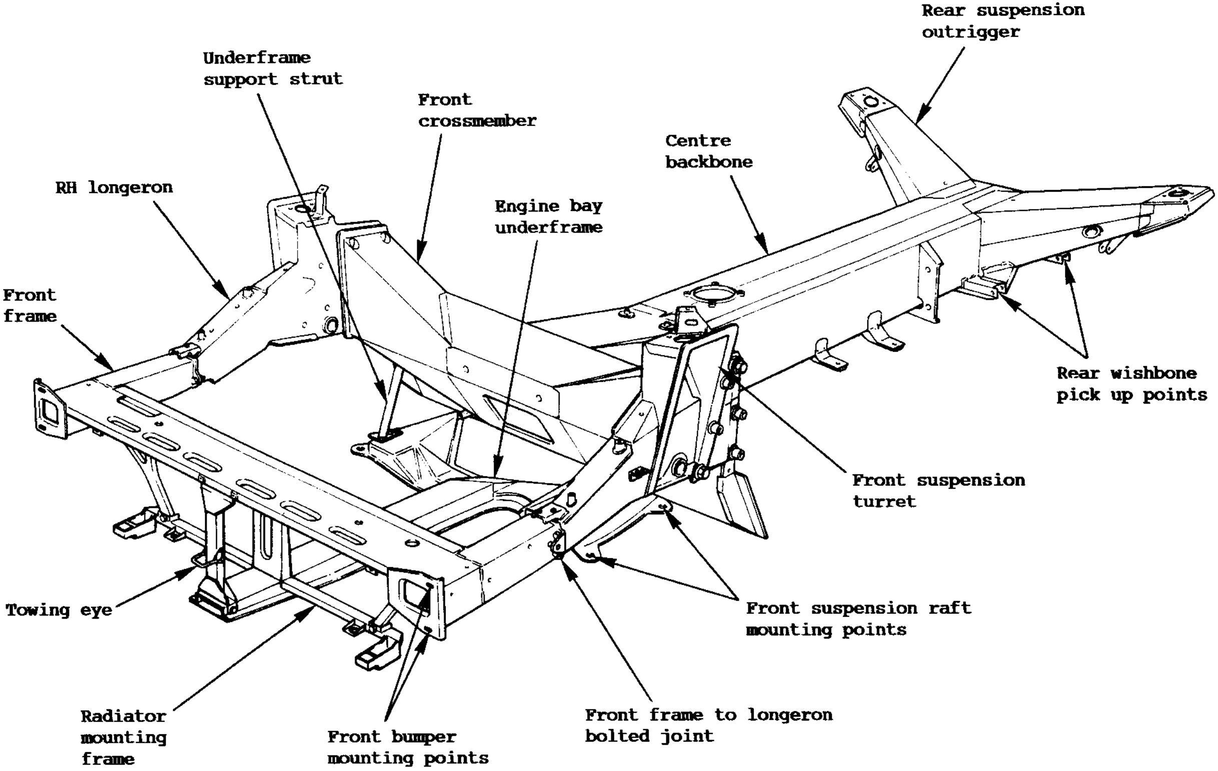
| | | Nm | lbf.ft |
|---|---|---|---|
| Refrigerant hose connections: | 5/8"-18 | 11 - 16 | 8 - 12 |
| | 3/4"-16 | 20 - 27 | 15 - 20 |
| | 7/8"-14 | 24 - 30 | 18 - 22 |
| | 1 1/16"-14/16 | 38 - 44 | 28 - 33 |
| **Clutch** | | | |
| Operating arm pinch bolt | | 38 | 28 |
| Clutch cover | | 19 | 14 |

# CHASSIS

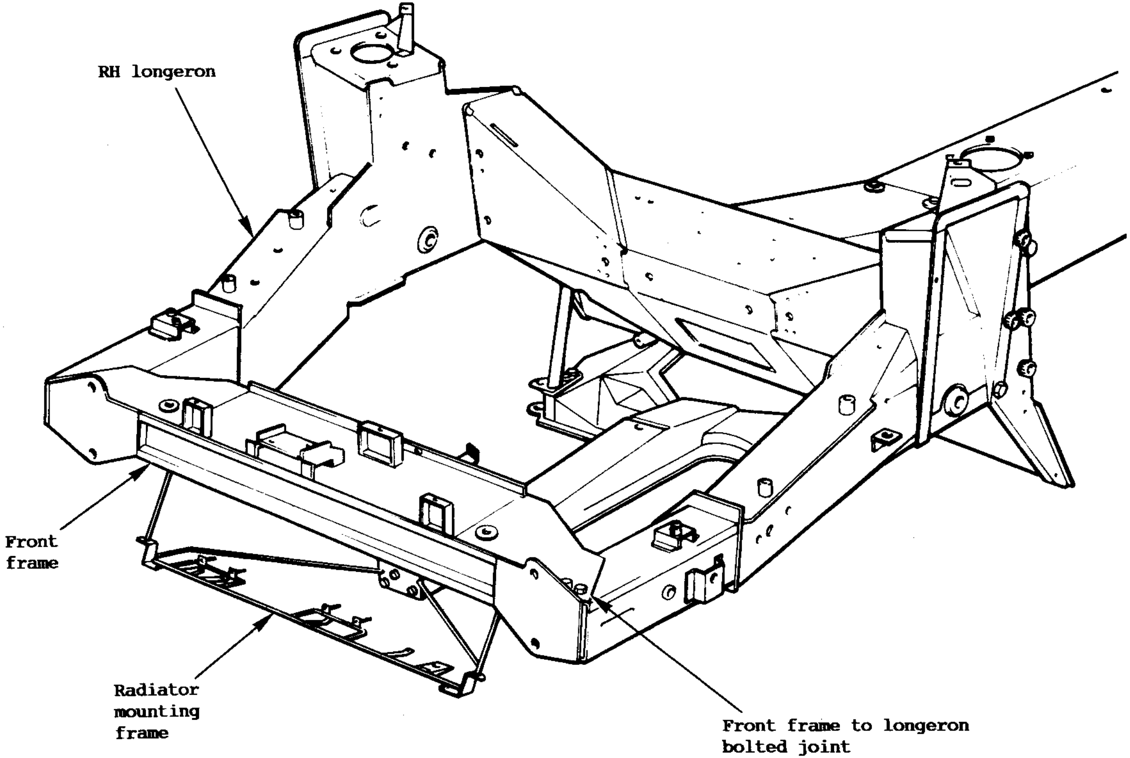
## SECTION AD - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | AD.1 | 4 |
| Change of Anti-Lift Angle | AD.2 | 5 |
| Dimensional Check | AD.3 | 6 |
| Longerons & Front Frame | AD.4 | 9 |
| Crash Structure | AD.5 | 12 |
| Body/Chassis Mounting Points | AD.6 | 16 |
| Chassis External Paint Repairs | AD.7 | 17 |

## Non-USA Type Chassis Assembly


Rear suspension outrigger
Underframe support strut
Front crossmember
Centre backbone
RH longeron
Engine bay underframe
Front frame
Rear wishbone pick up points
Front suspension turret
Towing eye
Front suspension raft mounting points
Radiator mounting frame
Front bumper mounting points
Front frame to longeron bolted joint

USA Type Chassis Front End


RH longeron
Front frame
Radiator mounting frame
Front frame to longeron bolted joint

## AD.1 - GENERAL DESCRIPTION

The chassis unit is fabricated principally from 'Zintec' electroplated zinc precoated steel sheet, and in certain critical areas, 'Tenform' high strength steel. Various welding processes are used in the construction of a central square box section 'backbone', with a crossmember at the front and two tapering box section outriggers at the rear. These outriggers form the top abutments for the rear suspension units, and carry the top link anchorage points. An extension of the centre backbone to the rear of the outriggers, carries the rearmost pivots for the wide based lower wishbones.

The chassis structure ahead of the front crossmember is bolted together for ease of assembly and repair, and carries the engine and transmission, front suspension, cooling radiators and front bodywork. This bolt-on structure differs in detail between USA and non-USA specification cars to suit the pertaining crash performance regulations, but the main components are similar:

- The chassis front crossmember provides mounting points for the two bolt on longerons, which extend forwards alongside the engine bay, and carry the front suspension unit top abutments, and the raft top bushes (see section CE). Each longeron is secured to the chassis front crossmember with six high tensile bolts, some of which are taper seat bolts for accurate location.
- A front frame is bolted between the front ends of the longerons, and provides the mounting points for the front bumper.
- A separate radiator support frame hangs from this front frame to form a mounting structure for the engine radiator and air conditioning evaporator.
- An engine bay underframe (prongeron) bolts to the bottom of the chassis front crossmember, carries the front suspension raft lower bushes, and extends forwards to bolt to the bottom of the radiator support frame.

On non-USA cars, a 'crash structure' is bonded to the top surface of the front frame, and consists of a composite box containing a series of composite tubes with longitudinal axes. The crush characteristics of the assembly are designed to provide a progressive collapse in the event of a frontal collision, and reduce the decelerative forces transmitted to the cabin and its occupants. On USA cars, a similar result is achieved by the use of an energy absorbing expanded aluminium honeycomb, bonded to the front frame and filling the space between the frame and front bumper.

Sixteen body to chassis mounting points take the form of caged nuts, and are widely distributed about the chassis, mating with plain hole aluminium bobbins incorporated in the body structure. Four of the body/chassis fixings also serve as inboard seat mountings.

The complete chassis frame is painted by an electrophoretic process before being coated with a grey polyester based anti-chip surfacer to protect the treatment from erosion. Further corrosion protection is provided by a 'Dinitrol' wax based coating, applied to the inner steel surfaces. The wax treatment process is manufactured, and the corrosion warranty administered by Dinol (GB) Ltd., with re-treatment inspections required after two years, and at two year intervals thereafter. For details of this warranty and retreatment/inspection, refer to the separate literature supplied by Dinol (GB) Ltd., Montalbo Road, Bernard Castle, Co. Durham, DL12 8EE.

Collision damage to the vehicle can subject parts of the chassis to abnormally high loads and initiate defects which may not be readily apparent. Consequently, if the vehicle's suspension or steering is damaged, then consideration must be given to secondary, or shock damage. For example, all mountings and mechanism attachments should be carefully examined for both mis-alignment and micro cracks. If any suspension pivot studs or suspension links are bent through collision impact, pay particular attention to the above points.

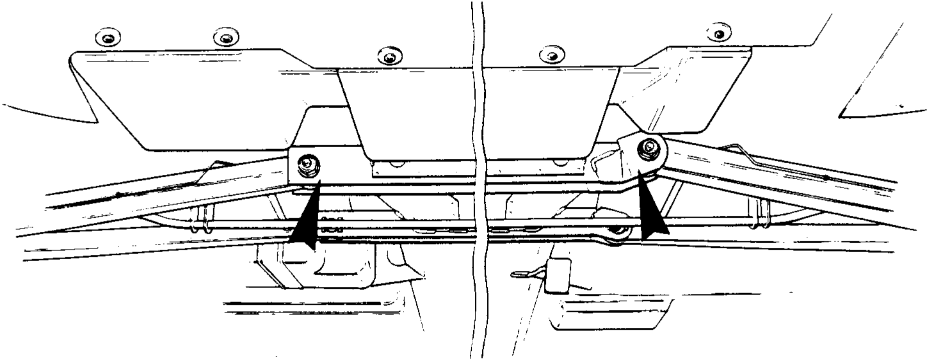
If any visible damage is found, such as panel wrinkling, broken welds, cracks etc, or if a dimensional check reveals any distortion, a **NEW CHASSIS** should be fitted. It is not recommended to perform any repairs to the chassis involving welding, heating, stretching or patching. The application of high temperatures to the chassis may cause internal stressing or weakening of the structure and incipient failure. In all cases, safety considerations must be regarded as paramount.

## AD.2 - CHANGE OF ANTI-LIFT ANGLE

The rear suspension geometry incorporates a feature designed to reduce the tendency of the rear of the vehicle to lift under braking. The angle between the rear lower wishbone inboard pivot axis and the horizontal when viewed from the side, is referred to as the anti-lift angle. This was changed from 5° to 2½° for all USA models, and as a running change on other vehicles from VIN M 6644, **excluding** 6645, 6646, 6652, 6715, 6716, 6718, 6719, 6721, 6723, 6727, 6730, 6768, 6769, 6788.

It is most important to establish the type of chassis fitted before carrying out a dimensional check. If a chassis type is in doubt (e.g. service replacement chassis) examine the rear wishbone anchorage channel at the extreme rear of the chassis, and refer to the diagram below.

**Straight channel - early type 5°** **Joggled channel - later type 2½°**



Note that the following rear suspension components differ between the two chassis variants:

- lower wishbones;
- top link inboard pivot stiffening struts;
- top link outboard pivot fixings;

For service replacement, only the later type 2½° chassis is available. If replacing the chassis on an earlier 5° car, the 2½° chassis must be fitted together with a rear suspension conversion kit A100D0093S, which consists of 2 rear wishbones, 2 top link struts, 2 top link outboard pivot spigot sleeves, 2 top link outboard pivot spacers, 2 top link outboard pivot bolts, and 2 Nyloc nuts. Refer to rear suspension sub-sections DD.4 and DD.5 for the correct assembly sequence.

## AD.3 - DIMENSIONAL CHECK

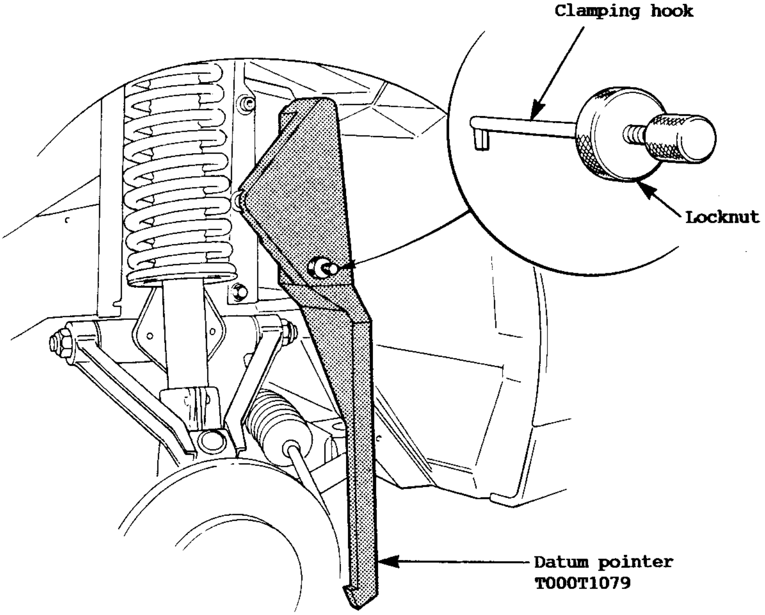
In general terms, when assessing accident damage, if after any suspension rebuild (if necessary) the specified suspension geometry can be achieved using such adjustment procedures as are specified in sections CE and DD, and a thorough visual inspection of the chassis reveals no signs of secondary damage, the chassis may be deemed serviceable.

In order to help assess chassis distortion without dissassembly of the suspension or body, a pair of chassis datum pointers may be mounted at the rear of the longerons, and measurements made from the datum points thus provided. Two types of datum pointer tool have been produced; machined aluminium and fabricated steel.

Tools required: Datum pointer, LH T000T1079 (aluminium) or T000T1231 (steel)
Datum pointer, RH T000T1200 (aluminium) or T000T1232 (steel)
4 off M12x1.75x70 Bolts A100W7099 - use only with steel pointers
3m steel tape measure

1. With the car raised on a wheel free lift, remove the front wheels and wheelarch liners.

2. Fit the datum pointers:
   **Machined aluminium type:** Position one of the datum pointers against the cap heads of the longeron fixing bolts, and fit the clamping hook through the pointer into the chassis hole. Pull the hook back to engage against the chassis, and tighten the lock nut securely.

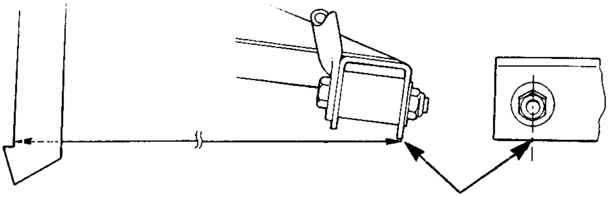


Fabricated steel type: Remove the top rear and bottom rear longeron to chassis bolts. Bolt the fabricated pointers the longerons/chassis using the M12x70 bolts.

3. Measure from the inside corner of an alloy pointer, or the tip of a steel pointer to one datum point at the rear of the channel section forming the chassis pick-up for the rear pivot of the rear lower wishbone (dimension A). Repeat for the opposite side.
4. Repeat (4), but measuring diagonally to the pick up point on the opposite side of the car (dimension B).
5. Measure across the car from one datum pointer to the other (dimension C).
6. Measure between the front and rear pick ups for the rear wishbone pivots on each side, as shown in the diagram (dimension D).
7. From inside the boot, measure between the centreline of the tops of the rearmost inboard studs, securing the top spring abutments to the chassis (dimension E).
8. Compare the measurements obtained above with those in the table below, and if any dimension is outside tolerance, a chassis distortion is indicated, necessitating chassis replacement.
9. To check the longerons and front frame, it is necessary to strip down the front of the car to enable measurements to be taken between the datum pointers and front bumper lower fixing holes. Alternatively, comparitive measurements can be taken between the steering rack mounting bosses in the chassis front crossmember and the bumper lower fixing holes.

| **Dimension** | **Tolerance (mm)** | | **Maximum Deviation** |
|---|---|---|---|
| | **Alloy Pointers** | **Steel Pointers** | **RH/LH** |
| A 5° anti-lift angle* | 2305 - 2322 | 2294 - 2311 | 8.5 |
| 2½° anti-lift angle* | 2308 - 2325 | 2297 - 2314 | 8.5 |
| B 5° anti-lift angle* | 2388 - 2408 | 2381 - 2401 | 9.5 |
| 2½° anti-lift angle* | 2392 - 2412 | 2384 - 2403 | 9.5 |
| * see sub-section AD.2 | | | |
| C | 1035 - 1047 | 1080 - 1092 | |
| D | 434.5 - 436.5 | 434.5 - 436.5 | |
| E | 886 - 890 | 886 - 890 | |
| F non-USA type | 1378 - 1396 | 1400 - 1418 | 8.5 |
| USA type | 1349 - 1367 | 1372 - 1390 | 8.5 |
| G non-USA type | 906 - 916 | 922 - 931 | 5.0 |
| USA type | 929 - 939 | 951 - 961 | 5.0 |

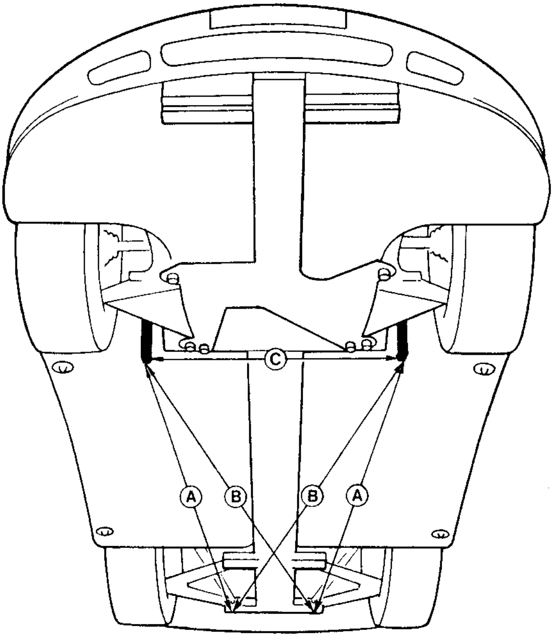
If no datum pointers are available, a drop check may be taken from datum points such as suspension pivots, longeron mountings etc., and the RH/LH deviation tolerances applied.

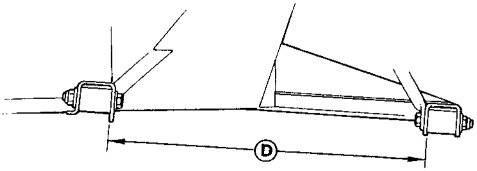


Inside corner of alloy datum pointer

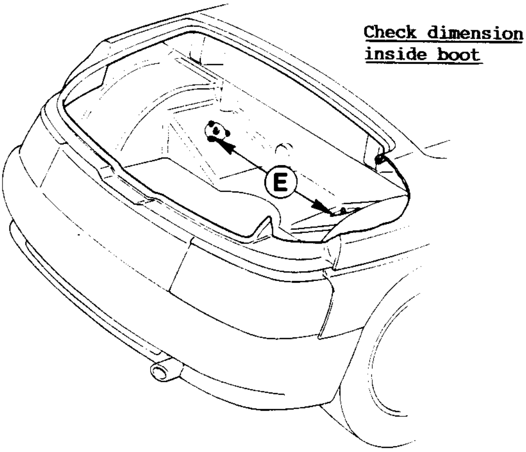
Rear side of channel section below centreline of pivot bolt

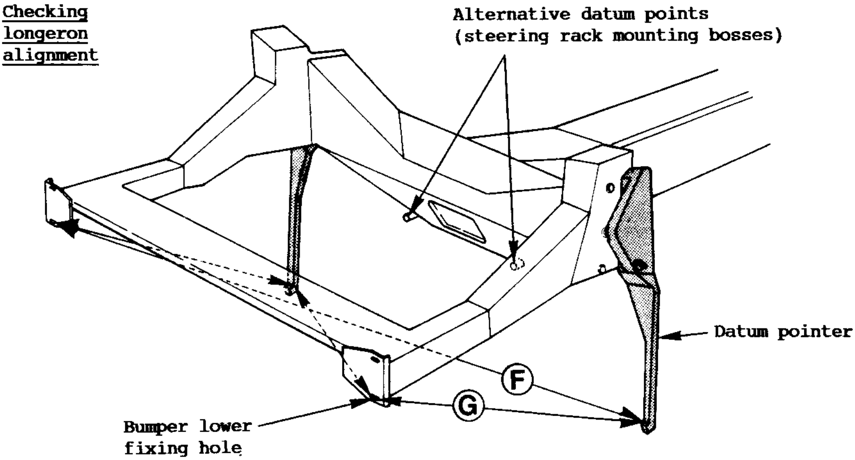
**Chassis Check Dimensions**





Inside surfaces of channel sections


Check dimension inside boot
E

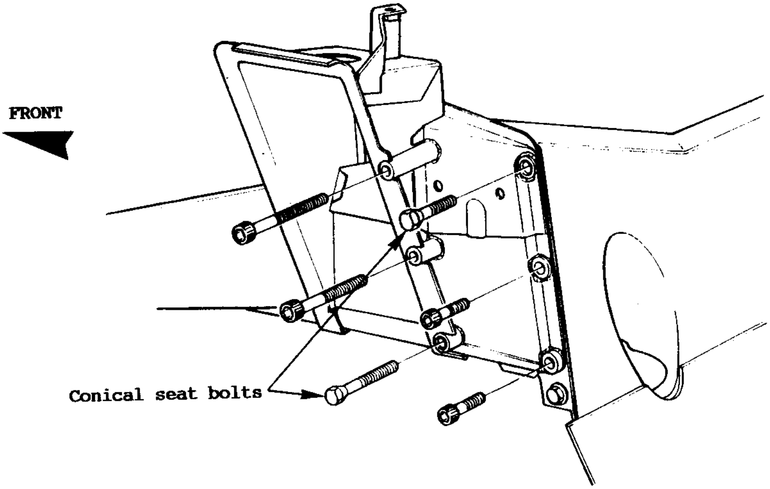

Checking longeron alignment
Alternative datum points (steering rack mounting bosses)
Datum pointer
F
G
Bumper lower fixing hole

AD.4 - LONGERONS & FRONT FRAME

The longerons and front frame differ between USA and non-USA models. On non-USA models, the longerons extend forwards as far as the left hand engine mounting, before bolting to the front frame which continues forwards before traversing across ahead of the power unit. On USA cars, the longerons extend all the way to the bumper mounting points before picking up the ends of the front frame.

Non-USA Cars

Each longeron is fitted to the end of the chassis front crossmember using six high tensile bolts, two of which are provided with conical seats for accurate location.



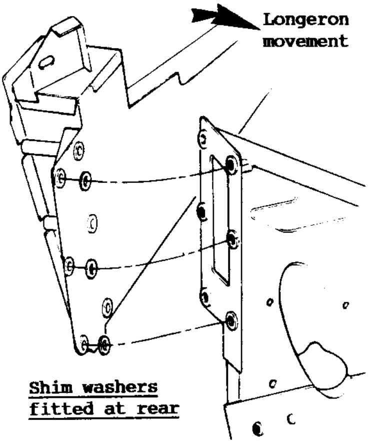
If necessary, shim washers are used at the joint between a longeron and the chassis to achieve optimum transverse alignment of the front end of the longeron. If a longeron is removed and is to be refitted on the same chassis, make a careful note of the location and number of these shims on disassembly, and rebuild to the same specification. Similarly, note any shims fitted at the joint between the longerons and front frame and refit in the same manner. All longeron fixing bolts should be fitted finger tight before torque tightening first the conical seat bolts, and then the cap head bolts, all to 120 Nm (89 lbf.ft).

If a new longeron or chassis is to be fitted, or if the original shimming build configuration is lost, the set up procedure detailed below must be followed to ensure optimum alignment of the longerons and front frame.

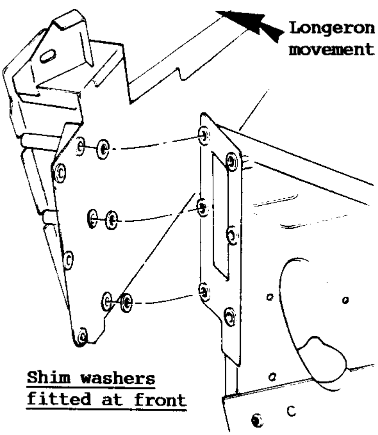
1. Fit the longerons to the chassis without any shims and nip up the bolts.

2. Offer up the front frame and check the alignment of the longeron/front frame fixing holes. If the longerons are too far apart or close together to allow the bolts to be fitted, it will be necessary to fit shims between the longeron(s) and chassis.

3. Two thicknesses of shim washer are available:
   0.25 mm A100A0806
   0.50 mm A100A0916
   If the ends of the longerons are too close together, shim washers should be fitted at the frontmost three longeron/chassis fixing points; and if too far apart, at the rearmost three fixing points. A 0.25 mm shim will produce approx. 1.25 mm movement at the front end of the longeron. Initially, the total shim pack required should be equally divided between the two longerons. At each longeron however, there must be an equal shim thickness at each of the three fixing points.


Longeron movement

Shim washers fitted at rear


Longeron movement

Shim washers fitted at front

4. When alignment of the front frame/longeron fixing holes has been achieved, it is necessary to check the 'squareness' or sideways alignment of the longerons. Fit the front frame.
   Measure the diagonal dimensions between the steering rack mounting bosses on the chassis front crossmember and the two lowermost front bumper fixing holes in the front frame. i.e. RH boss to LH bumper fixing hole, and LH boss to RH bumper fixing hole (see AD.3). If necessary, transfer longeron shims from one side to the other to move the front frame sideways and equalise the two diagonals. Transference of 0.25 mm in shim thickness will result in a 2 mm (approx) movement of the front frame.

5. Torque tighten the longeron to chassis fixings, beginning with the conical seat bolts, to 120 Nm (89 lbf.ft).
   Note that it is not necessary or practicable in service to shim the longeron to front frame joints. Tighten the longeron to front frame fixings to 22 Nm (16 lbf.ft).

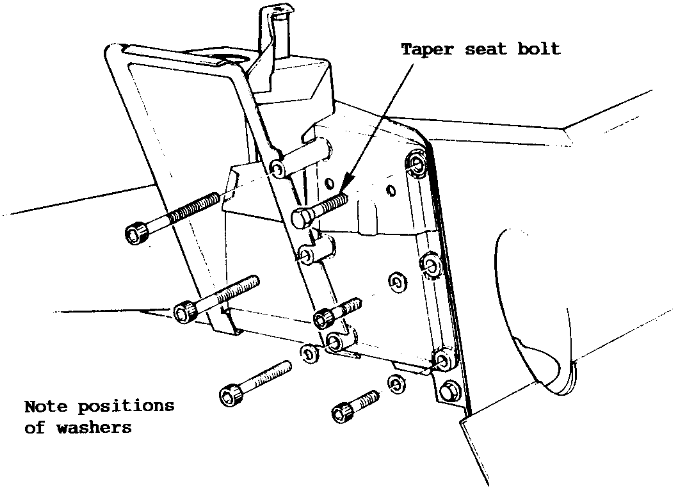
USA cars

On USA cars, the six fixings securing each longeron to the chassis utilise only one conical seat bolt instead of the two used on other models. This is to allow a marginal amount of vertical adjustment to be made to the front frame at the production stage. This adjustment is neither necessary nor practicable in service, and if the longeron fixings are slackened, they should be tightened with the vehicle (or chassis) weight supported by the longeron. Tighten the conical seat bolt first, followed by the cap head bolts, all to 120 Nm (89 lbf.ft). Note that some of the cap head bolts use flat washers beneath their heads.

If necessary, shim washers are used at the joint between the longerons and chassis to achieve optimum transverse alignment of the front frame, in the same way as on non-USA cars. See the procedure above to set up the longeron shimming reletive to the front frame and steering rack bosses.

Torque tighten the front frame to longeron fixings to 70 - 75 Nm (52 - 55 lbf.ft).

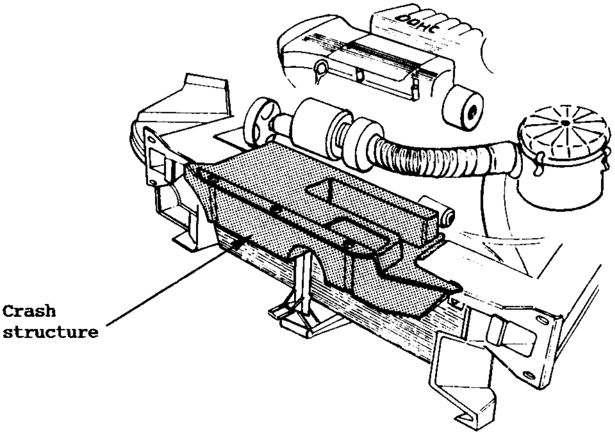
Earth braids are fitted on all cars between the inboard rear sides of each longeron, and the chassis front crossmember, with a shakeproof washer between the braid eyelet and the chassis member to ensure good electrical contact. In


Taper seat bolt
Note positions
of washers

addition, an earth braid is fitted across the joint between the left hand longeron and the front frame.

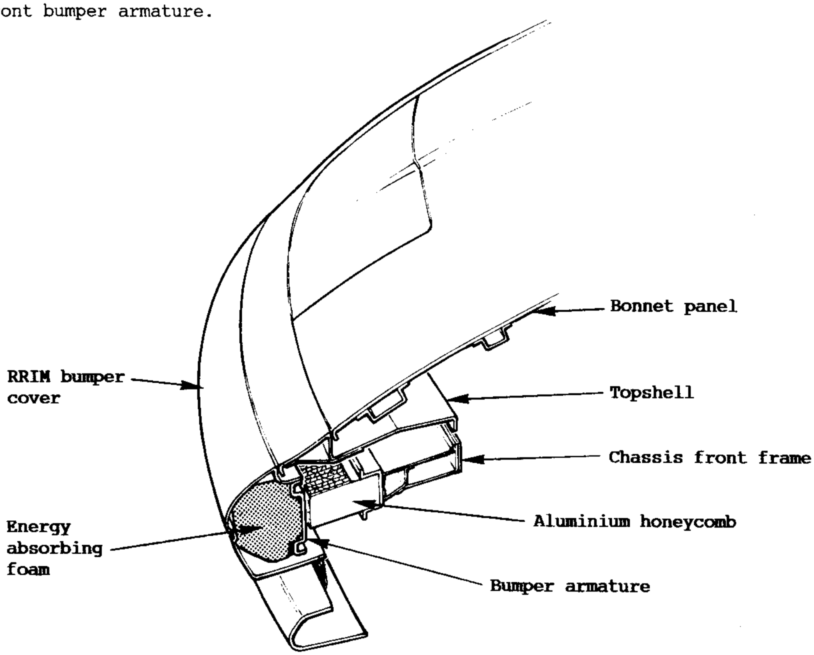
## AD.5 - CRASH STRUCTURE

On non-USA cars, a 'crash structure' is bonded to the top surface of the front frame, and consists of a composite box containing a series of composite tubes with longitudinal axes. The crush characteristics of the assembly are designed to provide a progressive collapse in the event of a frontal collision, and reduce the decelerative forces transmitted to the cabin and its occupants.


Crash
structure
DOHC

The structure is bonded to the top surface of the chassis front frame with polyurethane adhesive, and incorporates mounting points in the form of tapped aluminium bobbins, for the attachment of the electric water pump and front topshell.

On USA cars, the required progressive crush characteristic is achieved by the use of an energy absorbing expanded aluminium honeycomb, bonded into the front channel section of the front frame, and filling the space between the frame and front bumper armature.



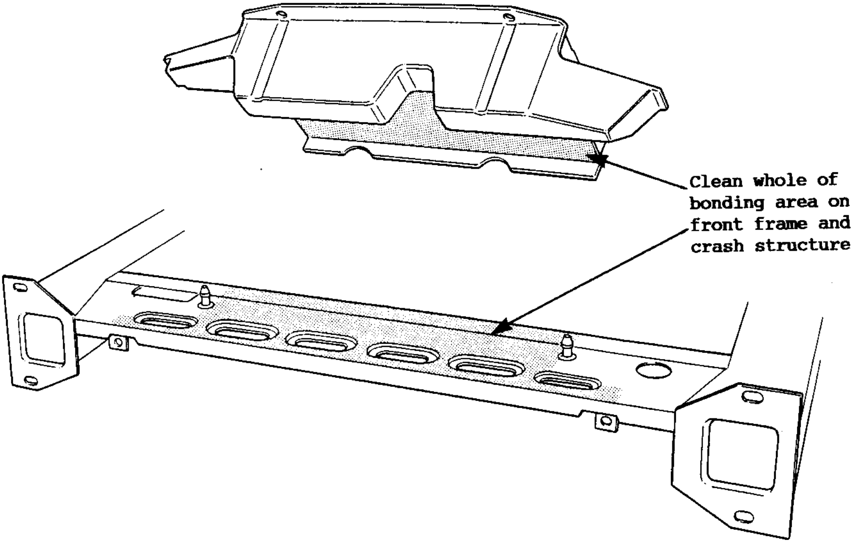
Neither type of crash structure is repairable, and if damaged should be cut from the front frame and a new structure fitted as detailed below.

Replacement of non-USA type crash structure

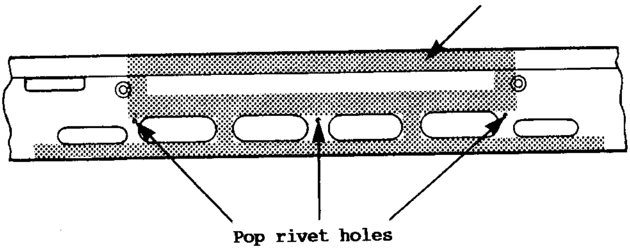
Materials Required: Betaseal Kit A075B6158F

1. The bonding surface on the top of the chassis front frame is not painted with the grey polyester surfacer, so that the adhesive can bond directly to the electrophoretic coat. Dry fit the box onto the frame and check that the three locating pop rivet holes are aligned.

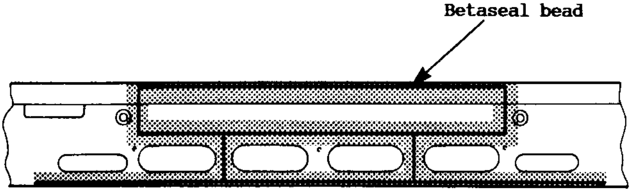
2. Clean the whole of the bonding area on the chassis frame and crash box with the wipe cleaner in the Beataseal kit. Wipe off the excess cleaner and allow to dry.


Clean whole of bonding area on front frame and crash structure

3. Shake the Betaseal primer container for at least 30 seconds before opening. Use a brush to apply the primer to the front frame as shown in the diagram, and also to the whole of the bonding area on the crash structure. Allow to dry for a minimum of ten minutes.


Primer band
Pop rivet holes

4. Cut the Betaseal nozzle at 45° so that the width of the nozzle tip is about 5 mm. Remove the desiccant from the HV3 cartridge, fit into the application gun, and extrude a bead of sealant onto the front frame as shown in the diagram.



5. Fit the box into position, and align the rivet holes. Press down using firm hand pressure to spread the adhesive, and fit the three pop pivets A075W6090 to secure the structure until the adhesive has cured. Paddle any extruded Betaseal back into the joint using a spatula.

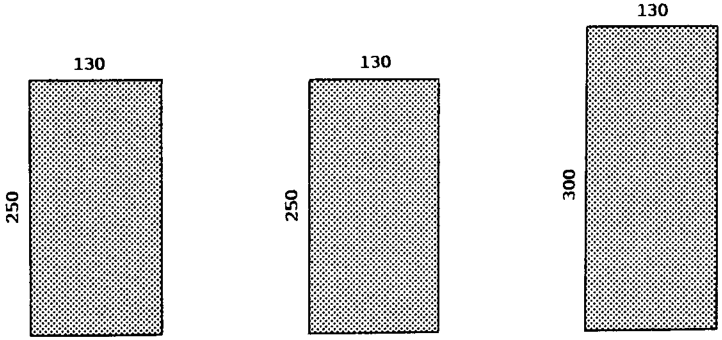
Precautions: Avoid skin or eye contact with the Betaseal adhesive, and inhalation of the vapour from the cleaner or primer. High concentrations of the vapours are noxious - use in conditions of good ventilation. Flash point 12 - 15°C.

Replacement of USA type crash structure

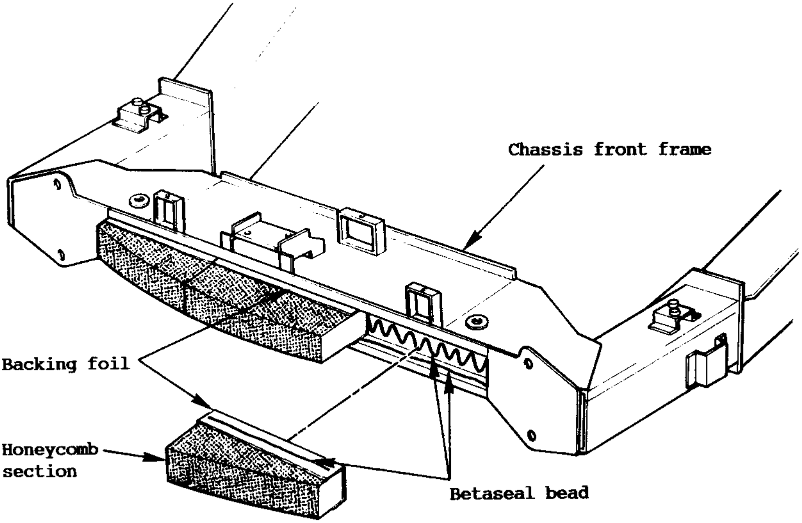
Materials required: Permabond V501 adhesive

1. Use Betaclean 3900, acetone, or a similar solvent to thoroughly degrease the recess in the front frame into which the honeycomb is to be fitted.

2. Cut three pieces of backing foil out of A065M6008V to the dimensions shown, and form each piece around the back of the honeycomb sections.



3. Stick each foil section to its honeycomb by applying a bead of Permabond V501 epoxy adhesive to the rear face, and rear edges of the top and bottom surfaces of each honeycomb section before pressing the foil into position.



4. For each of the three sections, apply a bead of adhesive to either the chassis or foil on each of the three mating surfaces, and press into position. Retain with tape until the adhesive has cured sufficiently (approx 2 hrs). Full strength is achieved after 24 hrs.

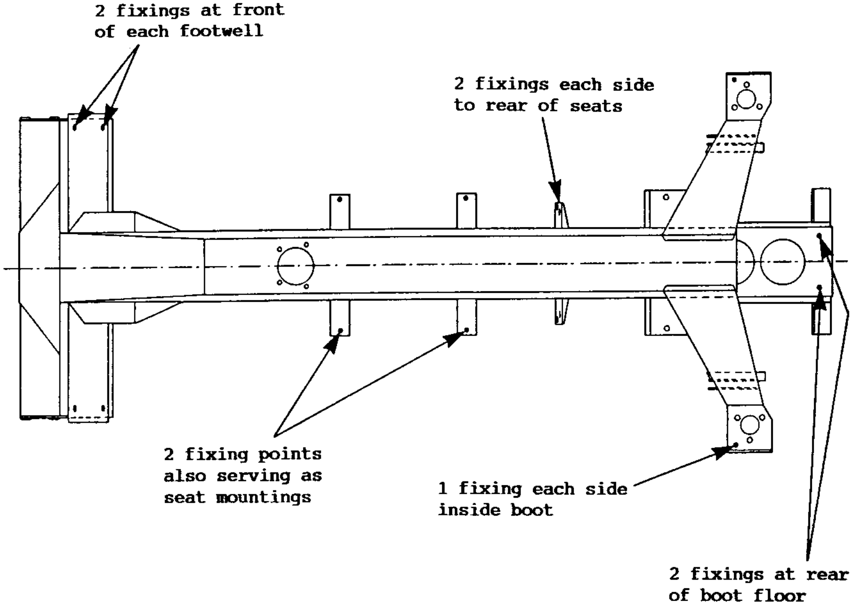
## AD.6 - BODY/CHASSIS MOUNTING POINTS

There are 16 main mounting points securing the body to the chassis, each using a two piece aluminium bobbin crimped together and bonded to the body, and an M10 bolt picking up in a caged nut on the chassis. The mounting points are symmetrical about the car centreline, and are located as follows:

- 2 at the front of each footwell, into the rear of the chassis front crossmember.
- 2 alongside the bottom of each side of the centre tunnel, also serving as seat mountings, and picking up short outriggers from the side of the chassis centre backbone.
- 2 in each side on the rear bulkhead, adjacent to the centre tunnel, picking up a bracket at the rear of the chassis backbone.
- 1 at each side of the boot, inboard of the rear wheel arch, into the chassis rear suspension top platform.
- 2 in the spare wheel well, into the chassis rear extension.

See section BK.17 for body/chassis removal procedure.

## Body/Chassis Fixings


2 fixings at front of each footwell
2 fixings each side to rear of seats
2 fixing points also serving as seat mountings
1 fixing each side inside boot
2 fixings at rear of boot floor

## AD.7 - CHASSIS EXTERNAL PAINT REPAIRS

In order to preserve the corrosion protection of the chassis, the polyester surfacer and electrophoretic coating ('E' coat), should be inspected for damage at the specified service intervals. Stone chips and scratches should be repaired and protected using Dinol products as follows:

1. Remove all loose paint, dirt and surface rust from the affected area, and thoroughly degrease using Dinol thinners. Using 800 grade emery paper, rub down any stone chips and scratches, and mildly key the surrounding good paint to accept the wax repair. Wipe over again with Dinol thinners.

2. Spray, at low pressure, a single coat of Dinol 3125 thixotropic rust-preventative fluid to the area, followed by a single coat of Tectacote 205 thixotropic wax coating, wet on wet. Allow approx. one hour air drying time.

Both these products (Dinol 3125 & Tectacote 205) are available from Dinol at Montalbo Road, Barnard Castle, Co. Durham, DL12 8EE, England., and may be applied using the same equipment as is used for the anti-corrosion guarantee wax re-treatment.

## PAINT PROCEDURE

### SECTION BH - ELAN

| | Sub-Section | Page |
|---|---|---|
| Paint Codes | BH. 1 | 2 |
| Essential Working Practice | BH. 2 | 3 |
| Preparation for Primer | BH. 3 | 3 |
| Application of Primer | BH. 4 | 4 |
| Preparation for Colour Coating | BH. 5 | 5 |
| Application of Mono Colour and Clearcoat | BH. 6 | 6 |
| Application of Metallic Colour Coat and Clearcoat | BH. 7 | 8 |
| Final Polishing Operation | BH. 8 | 9 |
| Paint Procedure for RRIM Components | BH. 9 | 9 |
| Pearlescent White Paint Procedure | BH.10 | 10 |
| Paint Removal | BH.11 | 11 |
| Paint Rectification Procedures | BH.12 | 11 |

* * * * * * * * * * * * * * * * * * * * * * * *

The procedures detailed in this section are based on those used in the manufacture of Lotus cars, and start with the bare composite bodyshell. The section is included only for general guidance in repair work, and does not constitute a complete service repair procedure. Note that different oven temperatures and thinners may be necessary dependent on the level of trim of the body, type of oven etc.

## BH.1 - PAINT CODES

A paint code number is stamped in the lower left hand corner of the vehicle identification plate fixed to the wheelarch in the front engine compartment. This code identifies the type and colour of paint used in manufacture.

'A' prefix paint codes are used for cars finished in two pack acrylic polyurethane materials, usually ICI P420 (mono colours) or P421 (metallic) type. 'P' prefix paint codes are used for pearlescent paint finished (see section BE.10).

| Paint Code | Colour | Manufacturers Reference No. | Lotus Part No. | Remarks |
|---|---|---|---|---|
| A21 | Monaco White | ICI P4207517 | A089B6149V | |
| A23 | Calypso Red | ICI P420GJ23 | A089B6150V | |
| A45 | Silver Frost | ICI P4217805 | A082B6087V | |
| A59 | Steel Blue | ICI P4218118M | A082B6116V | |
| A65 | Lotus New Racing Green | ICI P420GE51 | A089B6197V | |
| A68 | Pacific Blue | ICI P4217750 | A089B6196V | |

## BH.2 - ESSENTIAL WORKING PRACTICE

1. Warning
   Autocolour 2K hardener P210-770 (used with all ICI two pack acrylic-polyurethane systems) contains reactive isocyanate, a small portion of which is volatile. Vapour should not be allowed to accumulate in a confined or badly ventilated space. The spray mist is harmful by inhalation and contact with skin and eyes.
   Autocolour 2K should only be used in a well ventilated area, preferably a suitable spray booth with efficient exhaust ventilation. Spray operators should wear air line breathing apparatus to BS4467 part 3, maintained according to BS4275. People entering the spraying area for short periods (up to 15 mins.) should wear a respirator to BS2091 with type CC canister.

   Before spraying Autocolour 2K, operators should refer to ICI Health and Safety Information Sheet PV1. Store thinners in accordance with the Petroleum (Consolidation) Act 1928 and the Petroleum Mixtures Order 1929; and in a cool place. Store paint, hardener and hardcoat in accordance with the Highly Inflammable Liquids and Liquified Petroleum Gas Regulations 1972. Use only a non-smoking area, and away from all sources of ignition. Take precautionary measures against static discharge. In case of fire, use foam or dry agent extinguishers. Contain any spillage with sand or earth. Do not allow to enter a drain or water course.

2. All air used for spraying or blow down should be filtered before use.

3. All precautions should be taken to ensure there is no oil or water contamination in the paint containers and air supply lines.

4. A high standard of cleanliness must be maintained with all spray equipment. Frequent cleaning of guns and the surrounding area and booth is necessary.

5. Oven temperatures, and temperatures in the spray booth, Tak Rag booth and main working areas should be checked daily, and periodic measurements of panel temperatures carried out.

6. It is absolutely essential that any surface to be sprayed is absolutely clean, dry and free from dust or sludge.

7. After any and each surface covering treatment including P38 filler, cellulose stopper, polyurethane primer, primer/surfacer, colour paint and clear laquer, it is essential that these be fully cured using a bank of infra red lights giving a 60°C panel temperature for the duration specified for the operation. this then must be allowed to air cool before further work.

## BH.3 - BODY AND COMPONENT PREPARATION FOR PRIMER

1. i) Check panels for voids, gel cracks

   ii) Voids and gel cracks should be routed out.

   iii) Using 120 grit paper, dry flat edges of cut where routing has been carried out.

   iv) Blow out dust.

v) Fill with P38 filler.

vi) Flat off excess P38 with 80 grit dry followed by 120 grit dry, leaving a very thin film of filler over edges of repairs to avoid scar show-through.

2. Dry flat the panels and component surface areas, using 120 grade paper (S.I.A.), to ensure that there is no trace of wax or gloss.

   The operation is a cleaning process in order to provide a suitable surface for painting and must present a completely scrubbed surface to key the primer.

   Flatting should be carried out with an orbital sander or D.A. (orbital sander) on flat surfaces and a flat, hand held block, in more restricted areas.

   Extra care is necessary to avoid gel coat rub-through on sharp corners. Edges and awkward shapes may be flatted using a Scotch pad.

3. Thoroughly vacuum clean the panels to be painted & the surrounding area and remove all foreign bodies.

4. Solvent wash panels and components using Isopropanol mixed 1:1 with deionised water and carry out a final check for gel cracks etc. Fill as required, as above.

5. Blow off panels/components to remove dust, water etc. from surfaces and recesses.

6. Check the area to be masked up and rewash with solvent if necessary.

7. Mask up entire body excluding the area to be sprayed.

## BH.4 APPLICATION OF PRIMER

1. Enter the spraybooth and thoroughly solvent wipe all surfaces using Isopropanol mixed 1:1 with de-ionised water.

   Ensure that new cloths of a woven material are used and that they are changed frequently during use, so as to maintain surface cleanliness.

2. Thoroughly tak rag all surfaces to be painted.

3. Primer Formulation From ICI or Brown Bros.

| | | | | |
|---|---|---|---|---|
| Hi Dur Rapide Primer | ICI P565-693 | 4 | Parts | A100B6022V |
| Hardener | ICI P210-770 | 1 | Part | A100B6023V |
| Thinner | ICE P850-1276 | 0.5 | Part | A100B6024V |

Viscosity 25-32 Seconds BS4 Cup @ 20 degrees C, Material Temperature

4. Spray Gun and Settings

Gun

Brinks Syphon 230
Air Cap 66 SDI
Nozzle 071
Needle 18-01-23

Setting

Air Pressure 50 PSI at the gun

5. Application

i) Spray 1 single pass.

ii) Flash off 10 minutes from start of spraying.

iii) Spray 1 double pass (cross coat).

iv) Flash off 15 minutes from start of spraying.

v) Spray 1 single pass. Total dry film build 100-150 un (4-6 thou). Apply a mist coat of 2K black as a guide coat for later flatting using a pot gun spraying from about 2 feet distance, trigger fully open.

iv) Flash off 20 minutes from start of (v).

6. Oven bake at 65 degrees C for 90 minutes.

7. Exit over, allow to cool, inspect and repair if required.

| | | | |
|---|---|---|---|
| Guide Coat Mix - | ICI 2K Black | 2 Parts | A089B6151V |
| | Hardener P210-770 | 1 Part | A100B6023V |
| | Thinner P850-1275 | 2 Part | A100B6025V |

## BH.5 - PREPARATION FOR COLOUR COATING

1) Wet flat the panels surface using hand blocks and 400 grit paper (3M) or D.A. with 320 grit paper wet.

   Care must be taken to avoid rubbing through the primer film, particularly on sharp corners. These areas may be flatted with a Scotch pad.

2) Dry thoroughly, solvent wipe using Isopropanol mixed 1:1 with de-ionised water and inspect.

3) Rectify any surface defects as required using P38 and stopper.

   Flat rectified areas with 320, 400 grit.

Solvent wipe rectified areas with Isopropanol, as above. Replace damaged masking as necessary.

4. Re-seal any rub throughs or rectified areas with Hi Dur primer.

| | | | |
|---|---|---|---|
| Hi Dur Mix | P565-693 | 4 Parts | From ICI or Brown Bros. |
| Hardener | P210-770 | 1 Part | |
| Thinner | P850-1196 | 1 Part | |

Air Dry 20 Minutes.

Lotus Recommended Intercoat Repair Gun Settings

Gun

| | |
|---|---|
| Brinks Syphon | 230 |
| Air Cap | 66 SDI |
| Nozzle | 071 |
| Needle | 18.01-23 |

Setting

Air Pressure 50 PSI At the gun

Wet flat using 400 grit paper.

5. Thoroughly wash the panels and component surfaces to be painted, using hose and brush. The final wash should be with de-ionised water ensuring full removal of all flatting sludge.

6. Remove all masking.

7. Dry thoroughly inside and out of the car and components. Vacuum clean the panels and remove all foreign bodies.

8. Remask entire body excluding area to be painted.

## BH.6 - APPLICATION OF MONO COLOUR COAT AND CLEARCOAT

1. Ensure that body and components are fully vacuum cleaned.

   Enter the tak rag area and thoroughly solvent wipe the panels and component surfaces to be painted using Isopropanol mixed 1:1 with de-ionised water. Ensure that new cloths of a woven material are used and that they are changed frequently during use, so as to maintain surface cleanliness.

   Mask any bonding areas.

2. Thoroughly tak rag all surfaces to be painted to remove all traces of dust.

### 3. Paint Formulation

From ICI or Brown Bros.

| | | | |
|---|---|---|---|
| P420 Line Mono Colour | ICI 2K | 4 Parts | |
| Hardener | ICI P210-770 | 2 parts | A100B6023V |
| Thinners | ICI P850-1275 | 1 Part | A100B6025V |
| or | ICI P850-1196 | | A076B6078V |

Viscosity from 16 to 19 Seconds BS4 Cup @ 20 Degrees C, Material Temperature

### 4. Clearcoat Formulation

| | | | |
|---|---|---|---|
| Clearcoat | ICI P190-435 | 4 Parts | A100B6027V |
| Hardener | ICI P210-770 | 2 Parts | A100B6023V |
| Thinner | ICI P850-1275 | 1 Part | A100B8602V |
| or | ICI P850-1196 | | A076B6078V |

### 5. Spray Gun and Settings

#### Gun

| | |
|---|---|
| Brinks Syphon | 230 |
| Air Cap | 66 SDI |
| Nozzle | 071 |
| Needle | 18.01-23 |

#### Settings

Air Pressure 65 to 70 PSI

### 6. Application

i) Blow down interior surfaces with filtered air.

ii) Tak rag to remove all traces of surface dust.

iii) Blow down external surfaces with filtered air.

iv) Spray 1 single pass of colour.

v) Flash off 10 minutes from start of spraying.

vi) Spray 2nd single pass of colour. Dry film build 30-50 um 1.5-2 thou).

vii) Flash off 40 minutes from start of spraying.

viii) Spray 1 double header (cross coat) (dry film 1½-2½ thou) no flash required.

7. Enter pre-stoving area, allow to dwell 40 minutes @ 40 degrees C to 50 degrees C.

8. Enter oven - bake @ 65 degrees C for a minimum of 90 minutes.

## BH.7 - APPLICATION OF METALLIC COLOUR COAT AND CLEAR COAT

1. Ensure that body and components are fully vacuum cleaned. Enter the tak rag area and thoroughly solvent wipe the entire car and component surfaces to be painted using Isoproponal mixed 1:1 with de-ionised water. Ensure that new cloths of a woven material are used and that they are changed frequently during use, so as to maintain surface cleanliness.

2. Thoroughly tak rag all surfaces to be painted to remove all traces of dust. Mask any bonding areas.

3. Paint Formulation From ICI or Brown Bros.

| | | | |
|---|---|---|---|
| P421 Line Metallic Colour | ICI 2K | 4 Parts | |
| Hardener | ICI P210-770 | 2 Parts | A100B6023V |
| Thinners | ICI P850-1196 | 2 Parts | A076B6078V |

Viscosity from 16 to 19 Seconds BS4 Cup @ 20 Degrees C, Material Temperature.

4. Clearcoat Formulation

| | | | | |
|---|---|---|---|---|
| Clearcoat | | ICI P190-435 | 4 Parts | A100B6027V |
| Hardener | | ICI P210-770 | 2 Parts | A100B6023V |
| Thinner | | ICI P850-1275 | 1 part | A100B6025V |
| | or | 1196 | | A076B6078V |

5. Spray Gun Settings

Gun

| | |
|---|---|
| Brinks Syphon | 230 |
| Air Cap | 66 SDI |
| Nozzle | 071 |
| Needle | 18.01-23 |

Settings

Air Pressure 65 to 70 PSI

6. Application

i) Blow down interior surfaces with filtered air.

ii) Tak rag to remove all traces of surface dust.

iii) Blow down external surfaces with filtered air.

iv) Spray 1 single pass of colour.

v) Flash off 10 minutes from start of spraying.

vi) Spray 2nd single pass of colour.

vii) Flash off 15 minutes from start of spraying.

viii) Spray double dust coat of colour, minimum film build 30-50 um (1.5-2 thou).

ix) Flash off 45 minutes from end of spraying.

x) Spray 1 single pass of clearcoat.

xi) Flash off 20 minutes from end of spraying.

xii) Spray 1 crosscoat dry film build 50-70 um (2-3 thou) of clearcoat. No flash off required.

7. Enter pre-stoving area, allow to dwell 40 minutes @ 40 degrees C to 50 degrees C.

8. Enter oven, bake at 65 degrees C for a minimum of 90 minutes.

## BH.8 - FINAL POLISHING OPERATION

1. Remove masking from car excluding all surfaces without paint.

2. Compound Formulation

   Rubbing compound fine 2B P562-32

3. All painted surfaces to be lightly compounded with a machine mop.

4. Wipe down with woven material and blow down painted surfaces.

5. Unmask entire car.

6. Clean up and wax.

## BH.9 - PAINT PROCEDURE FOR RRIM COMPONENTS

The front and rear bumpers are reinforced reaction injection mouldings (RRIMS) which may be distinguished by their more flexible 'rubbery' feel compared with glass fibre reinforced plastic (GFRP) composite mouldings. They are supplied only in primer for finishing in the colour required.

1. Preparation
   Use 400 grit carburundum paper to wet flat the panel and remove all surface irregularities. Do not rub through the primer (A082B4429V, ICI P571/500).

2. Colour Paint Application
   For metallic colours:

| | | | |
|---|---|---|---|
| Colour Paint | | P421 | 5 parts by volume |
| Flex Aid | A089B6121V | P100/2001 | 1 part by volume |
| Hardener | A100B6023V | P210/770 | 3 parts by volume |
| Thinner | A100B6025V | P850/1275 | To spraying viscosity |

For mono colours

| | | | |
|---|---|---|---|
| Colour Paint | | P420 | 5 parts by volume |
| Flex Aid | A089B6121V | P100/2001 | 1 part by volume |
| Hardener | A100B6023V | P210/770 | 3 parts by volume |
| Thinner | A100B6025V | P850/1275 | To spraying viscosity |

For either system, spray one single coat, allow 10 minutes to flash off, and spray one cross coat. Allow 30 minutes flash off before stoving at 60°C for 90 minutes. Rectify minorblemishes with cellulose stopper and prepare for spraying and second coat.
Spray second coat as above, and if necessary with metallic colours, a dust coat to minimise shading. For mono colours, allow 30 minutes flash off before stoving at 60°C for 90 minutes.

3. Clear Coat Application

| | | | |
|---|---|---|---|
| Clear Coat | A100B6027V | P190/435 | 5 parts by volume |
| Flex Aid | A089B6121V | P100/2001 | 1 part by volume |
| Hardener | A100B6023V | P210/770 | 3 parts by volume |
| Thinner | A100B6025V | P850/1275 | To spraying viscosity |

Spray one single coat of clear coat, allow 10 minutes to flash off, and spray one double coat. No flash off is necessary before stoving. Stove at 60°C for 90 minutes.

NOTE
RRIM components can only be stoved if jig supports are used to prevent distortion. Where jigs are not available, the paint may be air dried at room temperature for 10 to 12 hours minimum. Parts should not be fitted for 24 hours.

## BH.10 PEARLESCENT WHITE PAINT PROCEDURE

Cars finished in 'Pearlescent White' with paint code P02 should be painted as follows:_

1. Follow procedures BH.2, BH.3, BH.4 and BH.5 to apply Hi-Dur primer and to prepare for the colour coat.
2. Follow procedure BH.6 stages 1, 2 and 3 to apply Monaco White, ICI P4420-7517, and allow 45. min flash off before applying the pearlescent coat.

3. Pearlescent Finish: A089B6184V ICI P421-7865

| | | | |
|---|---|---|---|
| Mixing Ratio : | Pearlescent | | 2 parts by volume |
| | Hardener | P210/770 | 1 part by volume |
| | Thinners | P850/1275 | 1 part by volume |

Spraying viscosity is 16-18 secs., BS4 cup at 10°C material temperature.
Pressure at the gun 60 psi.
Spray 2 single passes to obtain a film thickness of 1 thou. approx. 5 min. flash off between coats.
Flash off 30-45 min. before clearcoat application.

4. Follow procedure BH.6 stages 4 to 9 to apply clearcoat and to polish.

RRIM Components in Pearlescent White

1. Follow procedure BH.9 to apply a colour coat of Monaco White ICI P420-7517.

2. Apply pearlescent finish: A089B6184V ICI P421-7865

| | | | |
|---|---|---|---|
| Mixing Ratio: | Pearlescent | | 5pbv |
| | Flexaid | P100 2001 | 1pbv |
| | Hardener | P210 7701 | 1.5pbv |
| | Thinners | P850 1275 | to spraying viscosity |

   Spraying viscosity is 16-18 secs. BS4 cup at 18°C material temperature.
   Spray 2 single passes to obtain a film thickness of 1 thou.
   approx. 5 min flash off between coats.
   Flash off 30-45 mins. before clearcoat application.

3. Follow procedure BH.9 to apply a clear coat of ICI P190-435.

## BH.11 - PAINT REMOVAL

Under no circumstances must "Paint Stripper" be used to remove paint from G.F.R.P. composite bodies or components as this will attack the gel-coat, which must remain intact.

The recommended procedure for removing paint is:-

1. Wash off with a slow thinner, or

2. Wet flat with an an approriate grade of paper dependent on the amount of paint to be removed.

## BH.12 - PAINT RECTIFICATION PROCEDURES

1. Orange Peel or Scratches Caused by Compounding

   These defects should be removed using ICI 2B rubbing compound. Use a machine mop keeping the mop moist and where possible moving the mop in a fore and aft direction.

   Continue with polishing using 'T-Cut' and a fresh polishing mop, again keeping the mop moist and moving in a fore and aft direction. Finally hand polish the car using clean cloth and Mirrorglaze MGM8.

2. Scars or Sinkages

   Where possible these defects should be removed by working the lacquer coat with 1200 grade paper wet (3M), rubbing compound and polish. Great care must be taken not to rub through the clear coat.

   If the problem is such that it cannot be removed by flatting then the area should be prepared as follows:-

   a. If necessary, remove adjacent trim and fittings.
   b. Wash the area with clean water.
   c. Clean with water mixed 1:1 with Isopropanol.

d. Dry off and blow out using filtered air.
e. If necessary, mask off surrounding areas.
f. Feather edge the faulty area by wet flatting using hand held blocks and 320 grade paper carborundum.
g. Wash with clean running water and dry off using filtered air.
h. If necessary, apply P38 to the fault and cure using infra red lights to give a panel temperature of 60°C for 10 minutes. Flat dry using flat pad and 120 paper (SIA).
i. Spot prime the area using Hi-Dur primer mixed and applied as in Section 2. Cure the primer using infra red lights to give a panel temperature of 60°C for 30 minutes.
j. When cool, again wet flat using 320 grade paper (3M) and hand held blocks. Wash with clean running water and dry using filtered air.
k. Tak rag the repair and surrounding masked off areas and apply colour coat and clear coat wet on wet as described in Section 6 using a fade out technique.
l. After the final flash off period has elapsed cure the paint using infra red lamps to give a panel temperature of 80°C for 30 minutes.
m. When cool, 1200 wet flat, compound and polish the rectified area, remove masking and refit trim.

3. Gel Cracks

Remove the paint, primer and gel coat over the cracked area feathering back the original paint surface. Apply P.38 and refinish as in (2) above.

4. Blisters

Rout out the blister just deep enough to expose the blister cavity and refinish as in (2) above.

5. Chips and Scratches

Wet Flat the fault using 360 paper carborundum and refinish as in 2j-m above.

## BODY REPAIR

### SECTION BJ - ELAN

| | Sub-Section | Page |
|---|---|---|
| Lotus Composite Body Features | BJ. 1 | 2 |
| Body Care | BJ. 2 | 3 |
| Body Structure | BJ. 3 | 4 |
| Accident Damage Assessment | BJ. 4 | 5 |
| Resin and Gel Mix | BJ. 5 | 6 |
| Basic Bonds and Joints | BJ. 6 | 8 |
| Superficial Defect Repairs | BJ. 7 | 8 |
| Replacement Undertray Sections and Panels | BJ. 8 | 9 |
| Bobbin Inserts | BJ. 9 | 10 |
| Undertray Assembly Damage Assessment | BJ.10 | 15 |
| Repair of Minor Cracks and Gel Cracks | BJ.11 | 16 |
| Repair of Minor Surface Non Structural Damage | BJ.12 | 19 |
| Introduction and Sequence of Bonded Panel Removal | BJ.13 | 20 |
| Removal and Replacement of Sill Section | BJ.14 | 22 |
| Removal and Replacement of Sill Without Removing 'A' and 'B' Post Covers | BJ.15 | 25 |
| Remove Rear Top Shell | BJ.16 | 28 |
| Remove Transom | BJ.17 | 28 |
| Remove Lower Quarter Panels | BJ.18 | 29 |
| Remove 'B' Post Cover | BJ.19 | 30 |
| Remove 'A' Post Cover | BJ.20 | 30 |
| Remove Sill | BJ.21 | 31 |
| Remove 'B' Post Diaphragm | BJ.22 | 31 |
| Remove Rear Bulkhead | BJ.23 | 32 |
| Introduction and Sequence of Bonded Panel Fitment | BJ.24 | 33 |
| Fit Front Bulkhead | BJ.25 | 36 |
| Fit Demist Duct Assembly to Front Bulkhead | BJ.26 | 38 |
| Fit HVAC Duct Plenum to Front Bulkhead | BJ.27 | 39 |
| Fit Steering Column Infill to Front Bulkhead | BJ.28 | 40 |
| Fit Rear Bulkhead | BJ.29 | 42 |
| Fit 'B' Post Diaphragm | BJ.30 | 43 |
| Fit Sill Infill and Sill | BJ.31 | 45 |
| Fit 'A' Post Cover | BJ.32 | 47 |
| Fit 'B' Post Cover | BJ.33 | 48 |
| Fit Rear Quarter Lower Panel | BJ.34 | 49 |
| Fit Rear Transom | BJ.35 | 51 |
| Fit Rear Top Shell | BJ.36 | 52 |
| Fit Fuel Filler Rebate | BJ.37 | 54 |
| Fit Battery Tray to Undertray | BJ.38 | 55 |
| Fit Fuel Strap Mounting Strengthening Bracket | BJ.39 | 56 |
| Fit 3 Centre Console Mounting Bracket | BJ.40 | 58 |
| Introduction to Undertray Repairs | BJ.41 | 59 |
| Repair Front Quarter Section of Undertray | BJ.42 | 60 |
| Repair Front Half Section of Undertray | BJ.43 | 69 |
| Repair Centre Section of Undertray | BJ.44 | 76 |
| Repair Mid Section of Undertray | BJ.45 | 81 |
| Repair Rear of Undertray | BJ.46 | 90 |
| Fit Outrigger to Undertray | BJ.47 | 93 |
| Fit Scuttle Beam | BJ.48 | 95 |
| Repair Fibre Glass Damage Around Bobbin | BJ.49 | 96 |
| Fit Bobbins to Undertray | BJ.50 | 97 |
| Fit 'B' Post Tie Brace | BJ.51 | 99 |
| Jigs Ect. | BJ.52 | 100 |
| Legislation | BJ.53 | 103 |

## BJ.1 - LOTUS COMPOSITE BODY FEATURES

**(Owner's Handbook Extract)**

**Body Features**

The body structure comprises a moulded composite floorpan reinforced with steel in key areas to form stiff box sections. The floor pan is bolted at sixteen points to the box section steel backbone chassis, with further rigidity and occupant protection provided by a high strength aluminium alloy windscreen frame, a tubular steel scuttle beam, and steel beams in the doors and 'B' post diaphragm. Most composite exterior panels are bonded to this structure using a flexible polyurethane adhesive, but the frontal panels are secured by threaded fasteners for ease of service access and collision repair. The front bumper/spoiler and rear/bumper valance are flexible reinforced polyurethane mouldings resistant to damage from minor knocks.

Composite structures have the ability to absorb high impact loads by progressive collapse, with impact damage being localised. In accident situations this feature protects the occupants from injurious shock loads and greatly reduces the danger of entrapment by deformation of body panels. This behaviour also facilitates repair by either replacing the damaged bolt on or bonded panels, and/or integrating replacement undertray sections with the undamaged area, using recognised approved methods which restore the undertray to its original condition without residual strain or distortion.

If the panel is deflected beyond its limits of flexibility the gel coat will be overstressed and cracks will result, although the panel will return to its original shape. A steel panel similarly treated would become permanently deformed.

The cracking may be confined to the surface gel coat with no reduction in panel strength, but if the damage is more severe the composite structure below the gel coat may be weakened. Localised repairs can be made in either case. Gel cracks may not appear immediately after overstressing because the effect can be masked by the flexibility of the paint finish which covers the gel coat. In some instances gel cracks can take as long as three months to appear. Gel cracks can be caused by, for example:-

- .Sitting or leaning heavily on the bonnet or any other panel.
- .Knocking doors against obstructions when opening.
- .Dropping a sharp or heavy object on a panel.
- .Allowing unsecured items to slide about in the boot (trunk).
- .Closing bonnet (hood) or boot (trunk) onto projecting objects, e.g. luggage or tools.
- .Attempting to deflect, or remove by force, parts attached to composite panels e.g. mirrors, locks, aerial etc., (action by vandals or even some mechanical car washes).
- .Incorrect jacking.
- .Collision with heavy rigid object.

Note that the bumpers are sacrificial members, which by absorbing light shock loads, protect the body from damage. Exceeding the bumper design loads, however, may cause gel crazing of the body panels.

## BJ.2 - BODYCARE

**(Owner's Handbook Extract)**

The finish of your Lotus is extremely resistant to all normal forms of atmospheric attack. Provided the simple maintenance procedure summarised below is followed, it will retain its gloss, colour and protective properties throughout the life of the vehicle. However, car finishes are not totally chemically resistant. Severe local contamination of an acid or an alkaline can occur. If it is left in contact with the paint film for any length of time, it may cause pitting and colour change.

### Washing

Many contaminants which will attack a paint film are water soluble. They will be removed before any harm occurs by thorough washing with plenty of water, to which is added a few drops of liquid detergent. Frequent washing is the best safeguard against unseen contaminants; at the same time ensuring the regular removal of dirt, dust and traffic film.

If washing with cold water is not effective, warm water and detergent will remove the gummy deposits exuded by some trees in the summer months. Petrol or white spirit will remove stains or the tar, bitumen and grease type.

### Polishing

Eventually some loss of gloss, and an accumulation of traffic film, will occur. At this stage, after the normal washing, a polish with a good quality liquid polish will restore the original lustre of the paint film.

Higher gloss of the paint film, and added protection against contamination, can be obtained by wax polishing. But it must be remembered that a wax polish can only be used successfully on a clean surface, and that the previous application must first be removed with white spirit or a liquid polish cleaner before re-waxing.

### Ventilation

Water lying on the paint surface for lengthy periods will penetrate the paint film. Although the effects will not be visible immediately, this will in fact cause a deterioration in the protective properties of the paint film.

If a car is garaged, good ventilation must be provided. Otherwise storage outside on a hard standing or under a carport of preferable.

### Summary

- .Wash frequently, using cold water with a few drops of liquid detergent added.
- .Inspect after a normal washing, and remove any local contamination with warm water, petrol or white spirit as appropriate.
- .Use a good quality liquid polish infrequently - say, twice a year - to restore high gloss and to remove accumulated traffic film and scum.
- .Park on a hard standing, and under conditions of good ventilation if a covered area is used.

**Windscreen**

When washing the windscreen, the wiper arms may be pivoted forward to clear the wipers from the glass and provide unrestricted access to the windscreen. Wash the wiper blade with clean water.

**Alloy Wheels**

It is recommended that these are washed with the preparation as is used to wash the bodywork. Use a brush having nylon bristles only. During the winter months, particularly when salt has been used on the roads for the dispersal of snow and ice, remove all wheels, and wash thoroughly to remove all accumulated road filth from wheels and tyres.

**Upholstery**

Normal cleaning consists of an occasional light wipe over with a cloth dampened in a mild soap and water solution; it is important that the cloth is only dampened, not soaked.

**Leather Upholstery**

The leather should be wiped over occasionally with a cloth dampened in warm soapy water only.

Repeat the operation using a fresh cloth and water only - avoid flooding the leather - finish by drying and polishing with a soft, dry cloth.

It is important to use a mild, non-caustic toilet soap (or 'Lux' soap flakes) and to avoid the use of petrol or detergents, furniture creams and polishes.

An occasional use of Cee Bee Hide Food is recommended after the leather has been in use for a year or two.

**Seat Belts cleaning**

The most suitable cleaner for seat belts is a mild soap and water solution since terylene does not absorb water to any extent and therefore will dry quite quickly.

Fluids which are harmful to terylene are those containing mineral acids and MUST NOT be used.

## BJ.3 - BODY STRUCTURE

The basis of the vehicle comprises of a one piece under tray and bonded panels made of G.F.R.P., which together with steel outriggers straddle a fabricated steel back bone chassis and bolt together via integral alloy bobbins at several mounting points.

A crash structure, which consists of longerons, a prongeron and a front frame is bolted to the front of the chassis.

The chassis is designed to carry all the major structural loads and is made of fabricated steel.

The crash structure which bolts to the front of the chassis is designed to take the suspension loads to chassis, carry the weight of the engine and progressively crush on impact.

The composite undertray, bulkheads and 'B' post diagram are designed to carry structural loads and when assemble each contributes to the strength and torsional stiffness of the whole assembly.

The composite body structure comprises of a one piece moulded undertray into which alloy bobbins are bonded and crimped. Two metal outriggers are bonded into the under tray, hollow section steel beams are fitted across the 'B' posts and 'A' posts to form an additional protective cage around the passenger compartment. The rear and front bulk heads are bonded into place before the 'A' and 'B' post covers, sills and rear panels are bonded into their respective positions.

The front panels, which are also made of G.F.R.P. are bolted to the main assembly.

The undertray is made from Isophthalic polyester/G.F.R.P. All other panels are of low profile G.F.R.P. construction.

All panels are produced using the Lotus Vari Moulding Process.

## BJ.4 - ACCIDENT DAMAGE ASSESSMENT

All damage to the body is covered in the following categories:-

a) Highly stressed
b) Moderately stressed
c) Lightly stressed

and on that definition depends the original construction and therefore the repair method to be employed.

As a general rule there should be a bonded joint wherever two panels touch, or wherever they close on important points. It is usually possible to check these bonds both visually and physically for fractures or breaks. Ascertain the cause of damage and the direction of impact and examine all panels or bonds which may have been affected.

A front end impact, for example, may easily cause the bonds at the bulkhead to split without the defect being easily visible.

To facilitate a closer examination, it may be necessary to remove parts and components to determine the extent of the damage. When determining the replacement undertray section and panels to be ordered, make sure the new under tray section and panels, when replaced will be attached to firm composite material; avoid badly crazed areas and badly burnt areas.

Fire damage is the most difficult to assess but generally only the obviously burnt or charred sections will need to be replaced or reinforced.

After a moderate or severe accident checks should also be carried out on the 'A' and 'B' post datum points, chassis, suspension and bobbin/fibreglass areas.

Note - Repair of damaged body area around bobbin may necessitate body removal from chassis.

### Accident Repairs

For repair purposes, accidents may be defined as either:-

a) Front section
b) Centre section
c) Rear section

and that definition determines the original construction and therefore the repair method employed.

a) Front Section
The front section has been designed for ease of panel replacement. Each panel may be removed by unbolting and its replacement bolted into position. A series of repair notes in this manual cover replacement of front section panels.

b) Centre Section
If severe damage occurs to the centre the whole body i.e. - undertray and all rear panels may have to be replaced. However on occasions it will be possible to replace sections of the undertray and outrigger. This may be achieved using conventional glass fibre repair techniques. A series of repair notes in this manual cover replacement of sections of the undertray.

c) Rear Section
The rear section of the car is comprised of the rear end of the undertray and body panels bonded into position using flexible polyurethane adhesive. Replacement of sections of the rear undertray may be carried out using conventional glass fibre repair techniques. The rear panels may be replaced by cutting the adhesive and removing the panels. When replacing bonded panels, adhesive must be applied and the panel positioned and secured while the adhesive cures. A series of repair notes in this manual cover the removal and replacement of rear body panels and replacement of rear sections of the undertray.

## BJ.5 - RESIN AND GEL MIX

The following contains information appertaining to the resin and gel mixtures which must be used when carrying out a repair.

The panels of this car are manufactured using two types of material. The materials are:-

1. Isophthalic polyester G.F.R.P.
2. Low profile
When carrying out a repair, the type of materials used will depend on the original material used in manufacture. The table below shows which materials must be used with each process.

| **MATERIALS** | **ISOPHTHALIC POLYESTER RESIN (Undertray)** | **LOW PROFILE RESIN (All other panels)** |
|---|---|---|
| Resin | 5566C8003 | Ashland Aropol 50437 |
| Resin Catalyst | BUTANOX 50-10cc per ltr. | BUTANOX LPT-10cc per ltr. |
| Filler | Nil | Millicarb-40 parts per 100 resin by weight |
| Gel | Brushing Clear H9E195 5618C8005 | |
| Gel Catalyst | BUTANOX 50-20cc per ltr. | |

Notes:-

1. The Millicarb filler must be mixed throughly with the Ashland Aropol 50437.

2. Ashland Aropol 50437 has a usable life of 30 days from the date of despatch by the manufacturers.

3. Resin 5566C8003 may be obtained from:-
   International Paint
   Silvertown
   London
   Tel: 01-476-3031

4. Ashland Aropol 50437 may be obtained in small quantities from:-
   Ashland U.K.
   Vale Industrial Estate
   Kiddermister
   Worcestershire
   DY11 7QP
   Tel: 0562-741583

5. Both of the Butanox Catalysts may be obtained in small quantities from:-
   Akzo Chemie
   1-5 Queens Road
   Hersham
   Walton on Thames
   Surrey
   KT12 5NL
   Tel: 0932-247891

6. Millicarb may be obtained in small quantities from:-
   Vetrotex Ltd
   3 Beadle Trading Estate
   Hithercroft Road
   Wallingford
   Oxon
   OX10 9RA
   Tel: 0491-35335

7. Gel coat brushing clear 5618C8005 may be obtained from:-
   International Paint
   Silvertown
   London
   Tel: 01-476-3031

Panel manufacturing material identification:-

a) Undertray-clear resin on inside surfaces
b) Low profile (all other panels) white on inside surfaces

## BJ.6 BASIC BONDS AND JOINTS

This section applies to the repair of an undertray.

Cut off the damaged portion after marking for re-positioning of the new panel. Clean and prepare both existing and new panels, removing all road filth, underseal and paint from existing panel. Cut new panel to fit existing leaving a gap of 1/8" to 1/4" between lining up with the previously marked positioning lines. Mate the two parts to be joined, leaving a gap of 1/8" to 1/4" between and using packing as necessary to achieve a perfect match. Joining plates (of angled section) should be attached to the exterior of the panel with the aid of self tapping screws or pop rivets. Using chopped-strand glass fibre mat of 3oz (2 x 1½ oz. or 2 x 450 gramms) total weight, together with resin and hardener, lay up by hand from the underside of the joint, ensuring an overlap of 8-10cm (3-4 in), leave to harden in a temperature of not less than 15°C.

When the repair has fully cured (hardened), and not before, remove the joining plates from the exterior surface sand out the top exposed joint, feathering outwards from the joint line, removing any old paint in the process. Fill the 1/8" to 1/4" gap with continuous length roving and resin, and whilst still wet, lay over one layer of 1½oz. chopped strand glass fibre mat together with resin and hardener, lay over one lay of the woven glass cloth 300 grams per metre squared together with resin and hardener, lastly lay over one layer of 1½oz. chopped strand glass fibre mat together with resin and hardener. Allow resin to dry and fully cure at a temperature of not less than 15°C.

## BJ.7 - SUPERFICIAL DEFECT REPAIRS

### Pin Holes or Air Voids

The only solution is to pick them out and fill the holes with a polyester stopper or filler. The two commonly used methods of filling these small holes are, (a) drilling or routing out so as to leave a larger hole with near vertical walls, or (b) enlarge by gouging or "picking out".

### SURFACE CRAZING

There are various causes of surface crazing, but practically all are caused by sharp impacts or accidental damage. During an accident some panels may flex sufficiently to cause the surface to craze without causing immediate apparent damage to the paint surface. The crazing may not work its way through the paint surface for some weeks so that it is necessary when assessing accident damage to carefully examine all panels, particularly near cracks or split bonds and in cases of doubt it may be possible to promote the appearance of the crazing by applying gentle heat.

Surface crazing itself generally stops at the first layer of glass fibre and is consequently not in itself structurally serious, but the extensive crazing near damaged areas should be taken as an indication of over stressing and the panel should be reinforced or replaced. It is not possible to remedy crazing by simply re-surfacing with a further layer of resin.

**Wrinkling or Distortion**

This phenomenon is usually caused by exposure to severe heat. This can cause the resin to soften slightly and in doing so give way to any inbuilt or associated stresses.

## BJ.8 - REPLACEMENT SECTIONS AND PANELS

Where the repair of a damaged vehicle calls for replacement sections and panels they may be obtained direct from Lotus Cars (Service) Ltd.

Where severe damage has been sustained, the damaged section of the undertray may be cut away, and a replacement section grafted in.

Before cutting away any damaged undertray section or before ordering replacements, the proposed method of repair, positioning of joint lines etc, should be ascertained. Determine a method of correct positioning of replacement sections, such as the "B" post striker, "A" post datum, seat bolt bobbins, or any prominent feature from which measurements can be made and scribe these clearly onto the section which is to be used. Use a marker to define the lines on which it is proposed to cut the section and study these lines thoroughly to see that:-

a) Any damaged section removed will allow adequate "pick-up" points on the replacement section to ensure it can be accurately positioned.
b) The proposed outline transverses longitudinal, lateral and horizontal definition points to assist easy lining up of the new section in all three planes.

Undertray sections are available as follows:-

1. **Front half** - this section includes the demist duct, front bulkhead, front of the undertray including the front seat bolt bobbins, the front section of both outriggers, both 'A' posts and both jacking points.

2. **Front quarter** - this section includes the front of undertray as far across as the tunnel, the front seat bolt bobbins, the front section of the outrigger, 'A' post, jacking point, and part of the bulkhead.

3. **Centre** - this section includes part of the bulkhead, the front of the undertray as far across as the tunnel, all four seat bolt bobbins, the beginning of the petrol tank recess and part of the rear wheelarch including the 'B' post tie brace bobbin. The outrigger will be supplied separately.

4. **Mid section** - this section includes the middle of the undertray as far across as the tunnel, the rear seat bobbins, the beginning of the petrol tank recess, part of the rear wheel arch including the 'B' post tie brace bobbin, the rear half of the outrigger and jacking point.

5. **Rear half** - this includes the rear section of the undertray, the two rear chassis bobbins and half of both wheel arches. It will cover the whole width of the boot.

6. **Rear quarter** - this includes the rear section of the undertray, one rear chassis bobbin and half of one wheel arch. It will cover half the width of the boot.

The front area of the car, as far as the bulkhead, has been designed to provide "bolt on" panel replacement. The rear of the car has been designed with bonded panels.

The sills, 'A' post covers and 'B' post covers are bonded.

The doors can be replaced in the conventional manner.

## BJ.9 - BOBBINS (METAL INSERTS)

Metal inserts are used at various points in the undertray to form secure and accurately located attachment points where high loads are involved. These inserts, referred to as bobbins of the bifurcated type.

The bifurcated type bobbins consist of male and female halves and are bonded to the undertray after lamination. The male half has a spigot which passes through the hole in the body and into the female half before being crimped over to firmly clamp the two halves to the under tray. These type of bobbins have only plain holes, of various diameters, with different length spigots to suit various material thickness.

### Bobbin Replacement

All new body sections are supplied complete with bobbins, but if a bobbin has to be replaced, for example after accident damage, follow the bobbin replacement procedure as follows:-

When the panel into which the bobbin is fitted has been fully repaired, drill a clearance hole for the bobbin spigot. Select a male bobbin with sufficient spigot length to provide enough protrusion through the female half of the bobbin and permit crimping of the spigot end to firmly clamp the assembly.

Before fitment of the bobbin roughen the area around the hole on both sides of the body, and apply a two part epoxy adhesive as specified. Fit the bobbin using a bobbin crimping tool. Complete the crimping operation and allow the adhesive to cure.

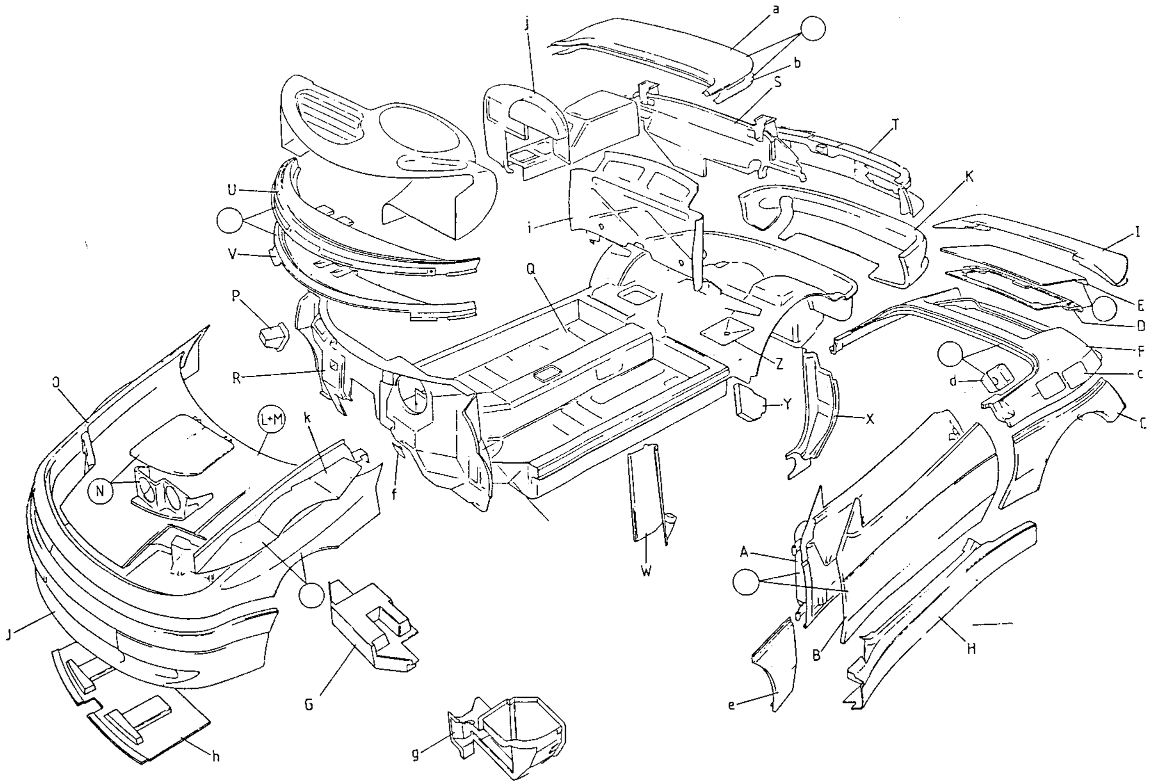
**Diagram Legend**

| REF | PART DESCRIPTION | REMARKS |
|---|---|---|
| A | (Door inner - LH/RH | Bonded Together |
| B | (Door inner - LH/RH | |
| C | Rear quarter lower RH/LH | |
| D | (Trunk lid inner. | Bonded Together Assy. |
| E | (Trunk lid outer. | |
| F | Rear Topshell | Bonded to (d) |
| G | Front crash structure assy. | Bonded to chassis |
| H | Rocker outer LH/RH sill | |
| I | Rear spoiler | |
| J | Front bumper - assy. | |
| K | Rear bumper - assy. | |
| L | (Hood inner and | Bonded Together Assy. |
| M | (Outer | |
| N | Hdlmp pod, flap inner & outer. LH/RH | Bonded |
| O | Front end top shell | Bonded to (k) |
| P | Ventilation duct plenum | |
| Q | Floor pan (undertray) | |
| R | Dash panel LHD/RH | |
| S | Rear bulkhead | |
| T | Rear Transom | |

| REF | PART DESCRIPTION | REMARKS |
|---|---|---|
| U | (De-mist duct upper. | Bonded Together Assy. |
| V | (De-mist duct lower | |
| W | 'A' post cover LH/RH | |
| X | 'B' post cover LH/RH | |
| Y | Rocker infill LH/RH | |
| Z | 'B' post infill tray LH | |

| REF. | DESCRIPTION | REMARKS |
|---|---|---|
| a | (Stowage lid outer | Bonded Together Assy. |
| b | (Stowage lid inner | |
| c | Fuel filler flap | |
| d | Fuel filler rebate | Bonded to (F) |
| e | 'A' Panel outer LH/RH | |
| f | Infill strg. column/ dash RHD | |
| g | Panel front quarter LH/RH | |
| h | Front panel undertray | |
| i | 'B' post diaphragm | |
| k | Ventilation LHD/RHD | Bonded to (O) |

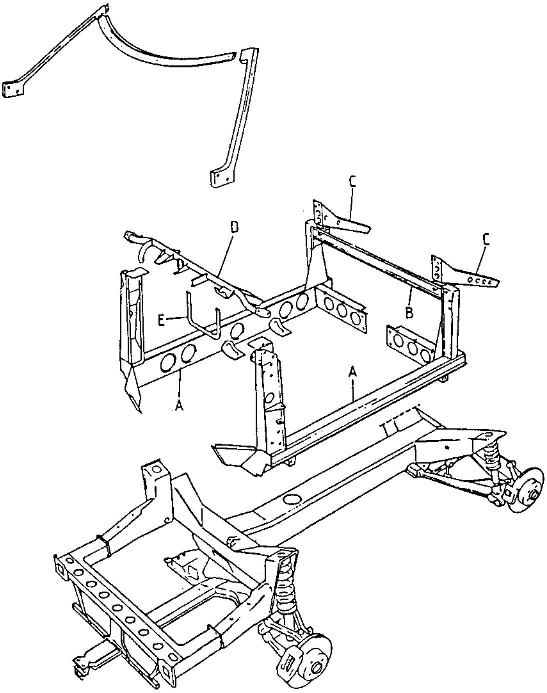
## Drawing No. BJ8-1 Panels


a
j
b
S
T
U
K
I
i
V
Q
E
D
P
F
Z
c
d
R
O
X
Y
C
L+M
k
N
f
A
W
J
B
H
G
e
h
g

## METAL STRUCTURE DRAWING LEGEND

| REF. | PART DESCRIPTION | REMARKS |
|---|---|---|
| A | Outrigger x 2 LH/RH | ) |
| B | 'B' post cross brace | ) Part of |
| C | 'B' post tie x 2 LH/RH | ) 1/2 Body |
| D | 'A' post cross brace | ) Assembly |
| E | Cross brace centre support | ) |

Drawing No. BJ-2 Steelwork



## BJ.10 - UNDERTRAY ASSEMBLY DAMAGE ASSESSMENTS

### Check Datum Points for Body Damage

**Special Tools**
Jig No. T000F0710

| Op. No. | Notes |
|---|---|
| 1. | Unbolt and remove both doors. |
| 2. | Remove striker plates from both 'B' posts. |
| 3. | Remove the grommets from the underneath of the four tooling holes in the undertray. |
| 4. | Fit jig to underneath of the four tooling holes, two 'A' post holes, and two 'B' post striker holes. |
| 5. | If the jig fits all the above points, the centre of the undertray and the outriggers are correctly positioned to each other. |
| 6. | If the jig does not fit all the above points it will be necessary to carry out repairs. |

### Check Movement of Body and Bobbin Security

In the event of an accident the following checks should be carried out on the body and bobbins:-

1. Body Movement Visual Check

   Check that the front face of the front bulk head is not in permanent contact with the rear face of the front section of the chassis.

2. Bobbin Security

   Check that the composite material around each bobbin remains undamaged.
   This is particularly important for the:-

   a) 'B' post tie braces/rear wheel arch bobbins
   b) Rear suspension/boot bobbins
   c) Toe and heel board bobbins
   d) Seat belt bobbins
   e) Fuel tank security bobbins

## BJ.11 - REPAIR OF MINOR CRACKS AND GEL CRACKS

The repair of minor cracks and gel cracks may be carried out in the three ways.

a) Repair of minor damage to the underneath of a panel.
b) Repair of minor damage to the gel coating of the top surface of a panel.
c) Filling of minor damage of the top surface of a panel.

### a) Repair of a minor damage to the underneath of a panel.

**Materials**

Resin
1½oz. Chopped strand mat
Acetone

**Special Tools**

Course paper

If the cracks have gone through the panel it will be necessary to to repair the damaged underneath of the panel as follows:-

| Op. No. | Notes |
|---|---|
| 1. | Course sand the underneath of panel around the crack. |
| 2. | Ensure area to be laminated is free from dust. |
| 3. | Brush area with acetone |
| 4. | Apply 1st coat of resin to panel |
| 5. | Apply two layers of resin impregnated 1½oz. chopped strand mat. |
| 6. | Roll and tamp down. |
| 7. | Apply 2nd coat of resin to chopped strand mat. |
| 8. | Leave resin to cure in a temperature of not less than 15°C. |

## b) Repair of minor damage to the gel coating of the top surface of a panel

**Materials**
Acetone
Brush Gel Coat - Grade 5618C8005
Fibre Glass Tissue 30 gramms per metre square

**Special Tools**
36 Grit paper

| Op. No. | Notes |
|---|---|
| 1. | Sand panel to remove minor cracks in gel coat. |
| 2. | Ensure area to be repaired is free from dust. |
| 3. | Brush sanded area with acetone. |
| 4. | Apply 1st coat of gel to sanded area. |
| 5. | Place 2 layers of fibre glass tissue 30 grams per metre squared on damaged area. |
| 6. | Roll and tamp down. |
| 7. | Apply 2nd coat of gel to fibre glass tissue 30 grams per metre squared |
| 8. | Leave gel coat to cure at a temperature of not less than 15°C. |

## c) Filling of minor damage of the top surface of a panel.

**Materials**
P38
Acetone

**Special Tools**
36 Grit paper
60 Grit paper
80 Grit paper
120 Grit paper

| Op. No. | Notes |
|---|---|
| 1. | Sand outside of panel with 36 grit paper to remove surplus gel. |
| 2. | Sand outside of panel with 60 grit paper to provide a key. |
| 3. | Ensure area to be repaired is free of dust. |
| 4. | Clean area with acetone. |
| 5. | Apply filler to area to be repaired ensuring surface of filler is slightly above surface of panel. |
| 6. | Allow filler to harden at a temperature of not less than 15°C. |
| 7. | Using a 60 grit paper remove excess filler and ensure that contours of the repaired area follow those of the car. |
| 8. | Hand sand with 60 grit paper to provide a better finish to the repaired area. |
| 9. | Hand sand with 80 grit paper to provide a better finish to the repaired area. |
| 10. | Hand sand with 120 grit paper to provide a better finish to the prepared area. |
| 11. | Place the prepared area under infa red heater lamps for two hours. IMPORTANT - Ensure the area does not overheat. |
| 12. | Check for distortions or shrinkage. |
| 13. | If distortion or shrinkage has occurred refill as necessary following the above procedures. |

## BJ.12 - REPAIR OF MINOR SURFACE NON STRUCTURAL DAMAGE TO SILL

**Materials**
P40
P38
Acetone

**Special Tools**
60 Grit paper
36 Grit paper
80 Grit paper
120 Grit paper

| Op. No. | Notes |
|---|---|
| 1. | Clean damaged area of sill and its surround with 60 grit paper to remove paint. |
| 2. | Ensure that area to be repaired is free from dust. |
| 3. | Clean area with acetone. |
| 4. | Apply P40 filler and leave for 30 minutes to harden. |
| 5. | Sand P40 filler with 36 grit paper to fit contours of sill. |
| 6. | Ensure that area to be repaired is free from dust. |
| 7. | Wipe area with acetone. |
| 8. | Skim over P40 with P38 to fit contours of sill. |
| 9. | Leave for 30 minutes under infa red lamp to harden.<br>IMPORTANT - Ensure area does not overheat. |
| 10. | Sand P38 with 80 grit and then 120 grit paper. |

## BJ.13 - INTRODUCTION TO BONDED PANEL REMOVAL

The notes within this section cover removal procedures for the major rear panels.

These panels are bonded in position with a flexible polyurethane adhesive.

When removing these panels it will be necessary to use the following special tools:-

| | | |
|---|---|---|
| 1. | Lotus Panel Tool. | See drawing no. BJ13-1 |
| 2. | Wire Set. | See drawing no. BJ13-1 |

It may be possible to re-use undamaged panels if they are removed carefully.

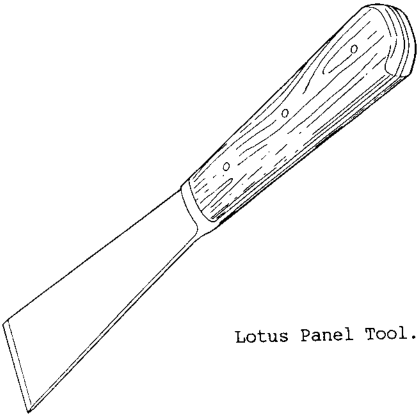
Before re-using panels remember to remove all traces of old adhesive and carry out the full re-bonding procedure i.e. clean, prime and apply fresh adhesive

Sequence of Dismantling Rear Bodywork

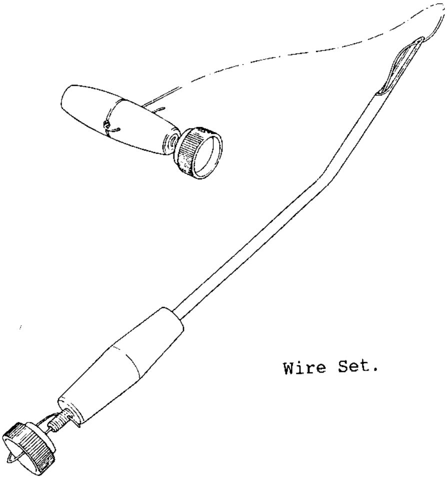
The following is the general sequence of dismantling the rear bodywork.

1. Remove boot lid.
2. Rear bumper.
3. Rear light covers.
4. Rear lights.
5. Disconnect and remove rear silencer box.
6. Remove hood stowage lid.
7. Remove petrol filler neck.
8. Remove top shell.
9. Remove transom.
10. Remove lower quarter panels.
11. Remove 'B' post covers.
12. Remove 'A' post covers.
13. Remove sills.
14. Remove 'B' post diaphragm.
15. Remove rear bulkhead.

**Drawing No. BJ13-1 Tools**



Lotus Panel Tool.



Wire Set.

## BJ.14 - REMOVAL AND REPLACEMENT OF SILL SECTION

**Components and Materials**

- Sill L.H. or R.H.
- 1½oz. C.S.M. (chopped strand mat)
- Resin
- Continuous length roving
- Acetone
- Fibre glass tissue 30 gramms per metre square
- Gel
- P38 filler

**Adhesives**

- Perma Bond V503
- Beta Wipe 3900
- Beta Prime 5402
- Beta Seal H.V.3.

**Special Tools**

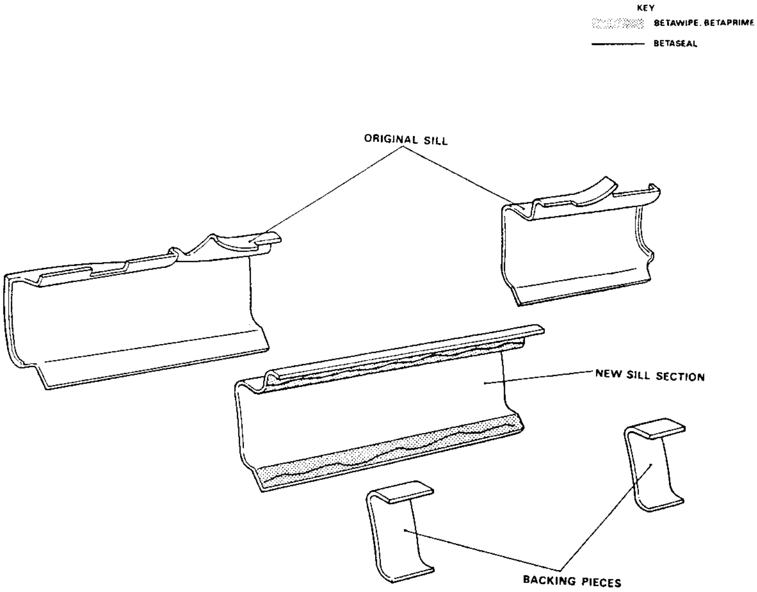
- Saw
- Lotus Panel Tool No. T000T1077
- Beta Seal Dispenser and Nozzle
- Masking Tape
- Marker
- 36 Grit Sandpaper
- 80 Grit Sandpaper
- 120 Grit Sandpaper
- Vox Cartridge Manual Gun and Nozzle

| Op. No. | Notes |
|---|---|
| 1 | Using saw and Lotus Panel Tool cut as necessary, and remove damaged sill. Using 36 grit sandpaper and mechanical sander clean old adhesive from outrigger and undertray. |
| 2. | Using damaged section of sill mark cut lines on new sill. |
|  | **To make backing pieces** |
| 3. | Apply tape to cover inside area up to 3" either side of both cut lines on new sill and ensure area around tape is free from dust. |
| 4. | Apply one coat of gel to tape and allow to dry. |
| 5. | Apply two layers of resin impregnated 1½oz. chopped strand mat to tape - roll & tamp down. |
| 6. | Allow resin to cure at a temperature of not less than 15°C. |
| 7. | Remove two backing pieces and tape from sill. |
|  | **Finish making backing pieces** |
| 8. | Using saw cut along both cut lines on new sill to create new sill section. |

| Op. No. | Notes |
|---|---|
| 9. | Clean and abraid bonding surfaces of old sill sections, new sill section and backing strips - ensure all bonding surfaces are free from dust. |
| 10. | Apply Perma Bond V503 to old sill bonding surfaces of backing strips as per manufactures instructions. |
| 11. | Attach backing strips to old sill sections leaving at least 2" (50mm) protruding from old sill section and secure with self tapping screws. |
| 12. | Clean new sill sections backing strip bonding surfaces and ensure that it is free from dust. |
| 13. | Apply Beta Wipe 3900 to clean bonding surfaces of new sill section, outrigger and under tray as shown in drawing no. BJ14-1. |
| 14. | Apply Beta Prime 5402 to bonding surfaces of new sill section, outrigger and under tray, as shown in drawing No. BJ14-1. |
| 15. | Apply Beta Seal HV3 to bonding surfaces of new sill as shown in drawing No. BJ14-1. |
| 16. | Apply Perma Bond V503 to new sill bonding section of backing strip as per manufacturers instruction. |
| 17. | Fit new sill to outrigger, under tray and backing strip ensuring 1/8" to 1/4" (3mm to 6mm) gap at each end and a Beta Seal bond gap of 2mm - secure with self tapping screws. |
| 18. | Allow Beta Seal 16 hours to cure. |
| 19. | When Perma Bond V503 has cured remove self tapping screws. |
| 20. | Using 36 Grit sand paper clean both sides of both edges to be laminated and feather outwards from the joint. |
| 21 | Ensure both areas which are to be laminated are free from dust. |
| 22. | Wipe both sanded areas with acetone. |
| 23. | Apply 2 layers of resin impregnated 1½ oz. chopped strand mat to each joint - roll tamp down. |
| 24. | Apply two layers of fibre glass tissue 30 grams per metre squared to each joint and stipple down. |
| 25. | Brush cover each joint with a layer of gel. |
| 26. | Leave resin to cure at a temperature of not less than 15°C. |

| Op. No. | Notes |
|---|---|
| 27. | Using a 36 grit sandpaper cut back gel. |
| 28. | Apply P38 filler as necessary. |
| 30. | Rub down P38 to suit contours of sill. |
| 31. | Using a 80 grit sandpaper rub down filler. |
| 32. | Using a 120 grit sandpaper rub down filler. |

**Drawing No. BJ14-1 Replacement of Sill Section**


KEY
▨ BETAWIPE, BETAPRIME
—— BETASEAL
ORIGINAL SILL
NEW SILL SECTION
BACKING PIECES

## BJ.15. - REMOVAL AND REPLACEMENT OF SILL WITHOUT REMOVING 'A' AND 'B' POST COVERS

**Components and Materials**
- Sill L.H. or R.H.
- 1½oz. CSM (chopped strand mat)
- Resin
- Continuous length roving
- Acetone
- Tissue
- Gel
- P38

**Adhesives**
- Perma Bond V503
- Beta Wipe 3900
- Beta Prime 5402
- Beta Seal HV.3

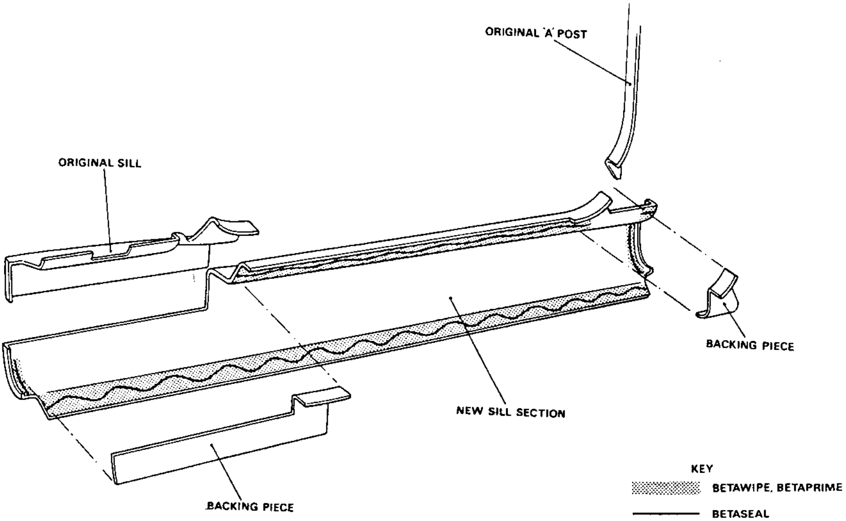
**Special Tools**
- Saw
- Lotus Panel Tool T000T1077
- Beta Seal Dispenser and Nozzle
- Tape
- Marker
- 36 Grit sand paper
- 80 Grit sand paper
- 120 Grit sand paper
- Vox cartridge Manual Gun and Nozzles

| Op. No. | Notes |
|---|---|
| 1. | Using saw cut through the join to release sill from 'A' post panel. |
| 2. | Using saw cut sill at rear end approximately 1½" from 'B' post cover and lower qtr. panel. |
| 3. | Using Lotus panel tool release and remove sill from out rigger. |
| 4. | Using removed section of sill, mark out cut lines on new sill. |
|  | **To make backing piece.** |
| 5. | Apply tape to cover inside area up to 3" either side of rear cut line on new sill. |
| 6. | Ensure area around tape is free from dust. |
| 7. | Apply one coat of gel to tape and allow to dry. |
| 8. | Apply two layers of resin impregnated 1½oz. chopped strand mat to tape - roll and tamp down. |

| Op. No. | Notes |
|---|---|
| 9. | Allow resin to cure in a temperature of not less than 15°C. |
| 10. | Remove backing piece and tape from new sill. |
|  | **Finish making backing piece.** |
| 11. | Using a saw cut along line on new sill to create new sill section. |
| 12. | Remove old sill under lapping section from underneath 'A' post. |
| 13. | Clean and abraid joining surfaces of old sill, new sill and backing strips and ensure all bonding surfaces are free from dust. |
| 14. | Clean joining surfaces of new sill and 'A' post. |
| 15. | Ensure area of sill and surrounds are is free from dust. |
| 16. | Apply Perma Bond V503 to old sill bonding surface of backing strip as per manufactbres instructions. |
| 17. | Fit backing piece to old sill section leaving at least 2" (50mm) protruding from old sill section and secure with self tapping screws. |
| 18. | Apply Beta Wipe 3900 to clean bonding surfaces of new sill section, outrigger, 'A' post cover and under tray as shown in drawing No. BJ15-1. |
| 19. | Apply Beta Prime 5402 to bonding surfaces of new sill section, outrigger, 'A' post cover and under tray as shown in drawing No. BJ15-1. |
| 20. | Apply Beta Seal H.V.3 to bonding surfaces of new sill section as shown in drawing No. BJ15-1. |
| 21. | Apply Perma Bond V503 to new sill bonding surface of backing strip as per manufacturers instruction. |
| 22. | Fit new sill to outrigger, under tray and backing strips ensuring 1/8" to 1/4" (3mm to 6mm) gap at each end and a Beta Seal Bond gap of 2mm - secure with self tapping screws. |
| 23. | Allow Beta Seal 16 hours to cure. |
| 24. | When Perma Bond V503 has cured remove self tapping screws. |
| 25. | Using 36 Grit sand paper clean areas to be laminated. |
| 26. | Feather both edges of both joint to be laminated. |

| Op. No. | Notes |
|---|---|
| 27. | Ensure area to be laminated is free from dust. |
| 28. | Wipe sanded areas with acetone. |
| 29. | Apply two layers of resin impregnated 1½oz chopped strand mat to both joints - roll and tamp down . |
| 30. | Apply two layers of fibre glass tissue 30 grams per metre squared to both joints and stipple down. |
| 31. | Cover both joints with a layer of gel. |
| 32. | Leave resin to cure at a temperature of not less than 15°C. |
| 33. | Using a 36 grit sand paper cut back gel. |
| 34. | Apply P38 filler as necessary. |
| 35. | Rub down P38 to suit contours of sill. |
| 36 | Using a 80 grit sand paper rub down filler. |
| 37. | Using a 120 grit sand paper rub down filler. |

**Drawing No. BJ15-1 Replacement of Sill without Removing 'A' & 'B' Post Covers**


ORIGINAL 'A' POST
ORIGINAL SILL
BACKING PIECE
NEW SILL SECTION
BACKING PIECE
KEY
▨ BETAWIPE, BETAPRIME
BETASEAL

## BJ.16 - REMOVE REAR TOP SHELL

**Component**
Rear Top Shell

**Special Tool**
Lotus Panel Tool T000T1077
Wire Set
36 grit paper and mechanical sander

**Note:** Provided this panel is initially undamaged it may be re-used if removed carefully.

Before removing the rear top shell it will be necessary to remove the boot lid.

| Op. No. | Notes |
|---|---|
| 1. | Using the Lotus panel tool separate the rear top shell from from the R.H. lower quarter, transom and L.H. lower quarter panels. |
| 2. | Using the wiring set separate the rear top shell from the rear bulkhead. |
| 3. | Using the Lotus panel tool separate the rear top shell from the 'B' post and 'B' post cover. |
| 4. | Using a 36 grit paper and mechanical sander remove all old adhesive from the above joining surfaces. |

## BJ.17 - REMOVE TRANSOM

**Component**
Transom

**Special Tools**
Wire Set
Lotus Panel Tool T000T1077
36 grit paper and mechanical sander

**Note:** Provided this panel is initially undamaged it may be re-used if carefully removed.

Before removing the rear transom it will be necessary to remove the boot lid and rear top shell.

| Op. No. | Notes |
|---|---|
| 1. | Using the wire set separate the transom from the undertray. |
| 2. | Using the Lotus panel tool separate the transom from the left hand and right hand lower quarter panels. |
| 3. | Using a 36 grit paper and mechanical sander remove all old adhesive from the above joining surfaces. |

## BJ.18 - REMOVE LOWER QUARTER PANELS

**Components**

L.H. and R.H. Lower Quarter Panels

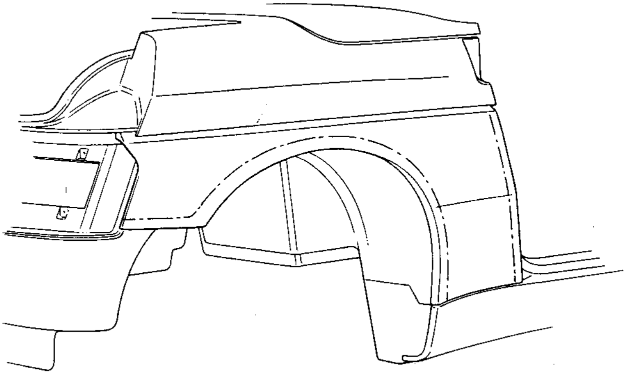
**Special Tools**

Router
Lotus Panel Tool T000T1077
36 grit paper and mechanical sander

Before remove removing the lower quarter panel it will be necessary to remove the boot lid, rear top shell & rear transom

| Op. No. | Notes |
|---|---|
| 1. | Using a router cut through the rear of the lower quarter panel just above the undertray. |
| 2. | Carefully rout along a line 1½" above the undertray and following the rear wheel arch to the 'B' post cover. |
| 3. | Using the Lotus panel tool separate the lower quarter panel from the 'B' post cover and discard. |
| 4. | Using the Lotus panel tool separate the remaining section of the lower quarter panel from the undertray |
| 5. | Using a 36 grit paper and mechanical sander remove all old adhesive from the undertray and 'B' post cover. |

**Drawing No. BJ18-1 Lower Quarter Panels - Rout Lines**



## BJ.19 - REMOVE 'B' POST COVER

**Components**
'B' Post Cover

**Special Tools**
Lotus Panel Tool T000T1077
36 Grit Paper and Mechanical Sander
**Note:** Provided this panel is initially undamaged it may be re-used if carefully removed.

Before removing the 'B' post cover it will be necessary to remove the boot lid, rear top shell, rear transom & rear lower quarter panel.

| Op. No. | Notes |
|---|---|
| 1. | Using the Lotus panel tool set separate the 'B' post cover from the sill, outrigger and 'B' post diaphragm. |
| 2. | Using a 36 grit paper and mechanical sander remove all old adhesive from the above joining surfaces. |

## BJ.20 - 'A' POST COVER

**Component**
'A' Post Cover

**Special Tools**
Router
Lotus Panel Tool T000T1077
36 grit paper and machanical sander

| Op. No. | Notes |
|---|---|
| 1. | Using router split the 'A' post cover down the middle. |
| 2. | Using the Lotus panel tool separate the 'A' post cover from the 'A' post and discard. |
| 3. | Using a 36 grit paper and mechanical sander remove all old adhesive from the 'A' post and front bulkhead etc. |

## BJ.21 - REMOVE SILL

**Components**
Sill

**Special Tools**
Lotus Panel Tool T000T1077
36 Grit Paper and Mechanical Sander

**Note:** Provided this panel is initially undamaged it may be re-used if carefully removed.

Before removing the sill it will be necessary to remove the boot lid, rear top shell, rear transom, rear lower quarter panel, 'B' post cover and 'A' post cover.

| Op. No. | Notes |
|---|---|
| 1. | Using Lotus panel tool remove the sill from the undertray and outrigger. |
| 2. | Using a 36 grit paper and mechanical sander remove all old adhesive from the undertray and outrigger. |

## BJ.22 - REMOVE 'B' POST DIAPHRAGM

**Components**
'B' Post Diaphragm

**Special Tools**
Lotus Panel Tool No. T000T1077
36 Grit paper and Mechanical Sander

**Note:** Providing this panel is initially undamaged it may be re-used if carefully removed.

Before removing the 'B' post diaphragm it will be necessary to remove the boot lid, rear top shell, rear transom, rear lower quarter panels and 'B' post cover.

| Op. No. | Notes |
|---|---|
| 1. | Using the Lotus panel tool set separate the 'B' post diaphragm from the 'B' posts, 'B' post cross brace, undertray and outrigger. |
| 2 | Using a 36 grit paper and mechanical sander remove all old adhesive from the above adjoining surfaces. |

## BJ.23 - REMOVE REAR BULKHEAD

**Component**
Rear Bulkhead

**Special Tools**
Wire Set
Lotus Panel Tool T000T1077
36 Grit Paper and Mechanical Sander

**Note:** Provided this panel is initially undamaged it may be re-used if carefully removed.

Before removing the rear bulkhead it will be necessary to remove the boot lid, rear top shell, rear transom and rear lower quarter panels.

| Op. No. | Notes |
|---|---|
| 1. | Using wire set and Lotus panel tool set as necessary separate the rear bulkhead from the undertray. |
| 2. | Using a 36 grit paper and mechanical sander remove all old sealants from the above adjoining surfaces. |

## BJ.24 - INTRODUCTION AND SEQUENCE OF BONDED PANEL FITMENT

When refitting used panels to this model care should be taken to ensure bonded surfaces are free of all old adhesive and the full rebonding procedure is carried out i.e. cleaning, bonding and applying fresh adhesive.

Where necessary jigs must be used to ensure the correct positioning of panels.

All bond gaps are to be 2mm wide unless otherwise stated.

Beta Seal H.V.3 requires 16 hours to cure and 24 hours to reach half strength.

The first page of this section offers a logical sequence of assembly for the major panels.

These notes are written for each individual panel.

**Fitment of Sealant Bonded Panels**

| Contents | Sequence of Assembly |
|---|---|
| Introduction | |
| Outriggers to Undertray | 1 |
| 'B' Post Cross Brace and Tie Braces to 'B' Post | 2 |
| Scuttle Beam to 'A' Post | 3 |
| 'B' Post Diaphragm to 'B' Post Cross Brace and 'B' posts | 4 |
| Rear Bulkhead to Undertray | 5 |
| Front Bulkhead to Undertray | 6 |
| Demist Duct Assembly to Front Bulkhead | 7 |
| H.V.A.C. Duct Plenum to Front Bulkhead | 8 |
| Steering Column Infill to Front Bulkhead | 9 |
| Sill Infill and Sill to Undertray and Outrigger | 10 |
| 'A' Post Cover to 'A' Post | 11 |
| 'B' Post Cover to 'B' Post | 12 |
| Rear Quarter Lower to 'B' Post Cover and undertray | 13 |
| Rear Transom to Undertray and Rear Quarter Lower | 14 |
| Rear Top Shell to Rear Bulkhead, Rear Lower Quarter and Transom | 15 |
| Fuel Filler Rebate | 16 |
| Battery Tray to Undertray | 17 |
| Fuel Strap Mounting Strengthening Bracket to Undertray | 18 |
| Centre Console Mounting Brackets to Undertrasy | 19 |

## Sealants

There are three systems of adhesives used in repair

**System 1**
For joining fibreglass to fibreglass or Ecote metal surfaces.

Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**System 2**
For joining untreated metal to fibre glass

Beta Wipe 3900
Beta Prime VP01706A] Two part primer
Beta Prime VP01706B]
Mix two part primer in 1 : 1 proportions -
Mix and leave for 20 mins. - apply and leave for 1 hour - bond surface to surface.
**IMPORTANT: OBSERVE MANUFACTURER'S HEALTH AND SAFETY REGULATIONS**

**System 3**
For windscreen glass surface

Beta Wipe V06040
Beta Prime 5001
Beta Seal H.V.3.

To manufacture 'special nozzle' Beta Seal from standard nozzle supplied:-

1. Select standard nozzle as shown.
2. Drill 2.8mm dia. hole - 34mm from end of c/l of hole.
3. Splice nozzle at end 60° to tangent of hole.

**Note:** Nozzle to be used only in conjunction with Winchester air operated gun.

See drawing no. BJ24-1

Allow Beta Seal H.V.3. 16 hours to cure before handling.
Beta Seal H.V.3. reaches half strength in 24 hours.
Leave a 2mm bond gap between joints.
Beta Seal has a 48 hour open life.
Beta Seal applicator Winchester Box Mk5b ac from P.C. Cox of Newbury.
Bonding bead to be 15mm wide and 2mm deep on all bonded joints.

Beta Products may be obtained from:-

Gurit - Essex (UK) Ltd.,
1B Gresham Road, Bermuda Industrial Estate,
Nuneaton, Warwickshire, CV10 7QR
Telephone No. 0203 - 37033.

There are two systems of glues used in repair

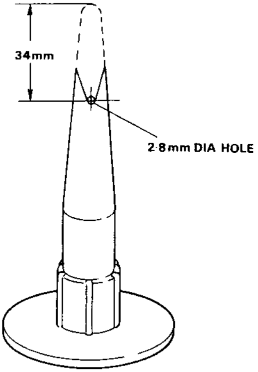
**System 1**
For joining the backing strips to the sill.
Perma Bond V503 (two part system in one tube).
**System 2**
For bobbins
Araldite 2002 (2 part)

Permabond products may be obtained from:-
Permabond Adhesives Ltd.,
Woodside Road,
Eastleigh,
Hants, S05 4EX.
Telephone: 0703 617127

Araldite Products may be obtained from:-
Brown Brothers Ltd.,
20-21 Kingsway,
City Trading Estate,
Norwich,
Norfolk, NR2 4UD.
Telephone: 0603 619232

Thicknessing wax 0,250" Part No. AA017674 may be obtained from
K. & C. Mouldings (England) Ltd.,
Spa House,
Shelfanger,
Diss, Norfolk. Telephone No. 0379 642660

**Drawing No. BJ24-1 Beta Seal Nozzle Design**



## BJ25 - FIT FRONT BULKHEAD

**Components**
Front Bulkhead

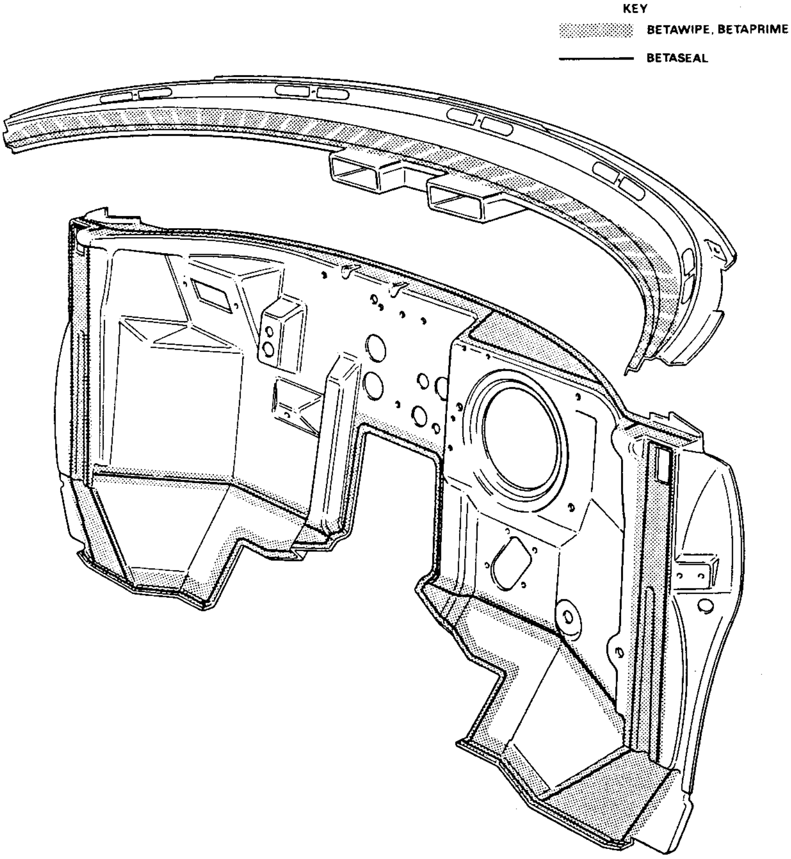
**Adhesives**
Beta Wipe 3900
Beta Prime 5400
Beta Seal H.V.3.

**Special Tools**
Height Gauge
Fibre Tip Marker
10mm Bolts
10mm Washer
½" Long Self Tap Screws
Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Position front bulkhead to undertray and ensure toe plate bobbin holes line up undertray toe plate bobbins. |
| 2. | Check height from underneath of undertray to underneath of front bulkhead top flange is 634mm. |
| 3. | Draw around front bulkhead so as to mark the correct position of the front bulkhead on the undertray using a fibre tip marker |
| 4. | Remove front bulkhead from undertray. |
| 5. | Apply Beta Wipe 3900 to clean bonding surfaces of front bulkhead and undertray as shown in drawing no. BJ25-1. |
| 6. | Apply Beta Prime 5402 to bonding surfaces of front bulkhead and undertray as shown in drawing no. BJ25-1. |
| 7. | Apply Beta Seal H.V.3. to bonding surfaces of undertray and on front bulkhead as shown in drawing no. BJ25-1. |
| 8. | Refit front bulkhead to undertray and re-check height from underneath of undertray to underneath of front bulkhead top flange is 634mm - ensure bond gap is 2mm. |
| 9. | Fit 4 bolts, washers and nuts to toe board and secure. |
| 10. | Fit 4 x ½" self tapping screws through front bulkhead and 'A' post. |
| 11. | Fit 2 x ½" self tapping screws through front bulkhead and toe board. |
| 12. | Fit 5 x ½" self tapping screws through front bulkhead and tunnel. |

| Op. No. | Notes |
|---|---|
| 13. | Re-check height from underneath of undertray to underneath of front bulkhead top flange is 634mm. |
| 14. | Remove excess Beta Seal from all joints. |
| 15. | Leave 16 hours for Beta Seal to cure. |
| 16. | Remove 4 bolts, washer and nuts from toe board. |

**Drawing No. BJ25-1 Front Bulkhead Bonding**



## BJ.26 - FIT DEMIST DUCT ASSEMBLY TO FRONT BULKHEAD

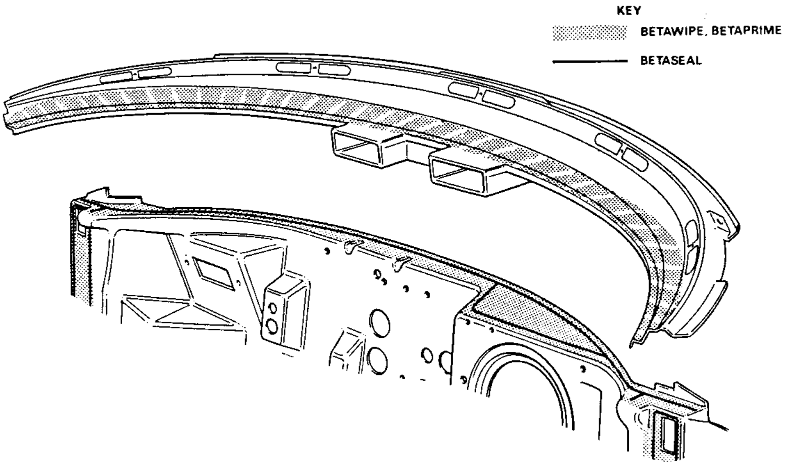
**Components**
Demist Duct Assembly

**Adhesives**
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tool**
Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of demist duct assembly and front bulkhead as shown in drawing no. BJ26-1. |
| 2. | Apply Beta Prime 5402 to bonding surfaces of demist duct assembly and front bulkhead as shown in drawing no. BJ26-1. |
| 3. | Apply Beta Seal H.V.3. to demist duct assembly as shown drawing no. BJ26-1. |
| 4. | Position duct assembly to front bulkhead and 'A' posts - ensure 2mm bond gap and distance from underside of undertray to the top of the uppermost ridge on the demist duct is 690mm. |
| 5. | Remove excess Beta Seal from joints. |
| 6. | Allow 16 hours for Beta Seal to cure. |

**Drawing No. BJ26-1 Demister Duct Bonding**



## BJ.27 - FIT HEATER VENTILATION AIR CONDITIONING DUCT PLENUM TO FRONT BULKHEAD

**Components**

H.V.A.C. Duct Plenum

**Adhesive**

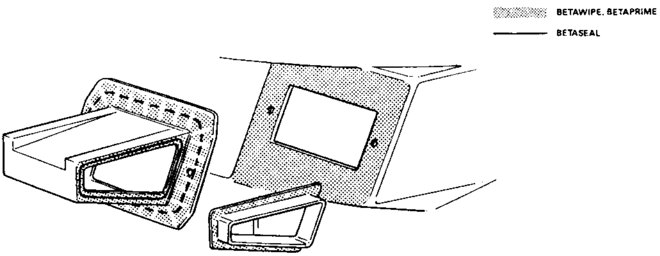
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tools**

Beta Seal Dispenser & Nozzle
2 Nuts & Bolts

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of H.V.A.C. duct plenum & front bulkhead as shown in drawing no. BJ27-1. |
| 2. | Apply Beta Prime 5402 to bonding surfaces of H.V.A.C. duct plenum and front bulkhead as shown in drawing no. BJ27-1. |
| 3. | Apply Beta Seal H.V.3. to bonding surfaces of H.V.A.C. duct plenum and front bulkhead as shown in drawing no. BJ27-1. |
| 4. | Position H.V.A.C duct plenum to front bulkhead ensuring a 2mm bond gap. |
| 5. | Fit 2 nuts and bolts and secure. |
| 6. | Remove excess Beta Seal from joints. |
| 7. | Leave 16 hours for Beta Seal to cure. |
| 8. | Remove bolts and nuts. |

**Drawing No. BJ27-1 H Vac. Duct Bonding**



## BJ.28 - FIT STEERING COLUMN INFILL TO FRONT BULKHEAD

**Components**

Steering Column Infill
Stud Plate
Steering Column Infill Gasket
4 Nuts

**Adhesives**

Beta Wipe 3900
Beta Prime 5402
Beta Prime 2 part (VPO1706A and VP01706B)
Beta Seal H.V.3.

**Special Tools**

Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to cleaning bonding surfaces of stud plate and front of front bulkhead as shown in drawing no. BJ28-1. |
| 2. | Apply Beta Prime 5402 to front surface of front bulkhead as shown in drawing no. BJ28-1. |
| 3. | Apply Beta Prime (2 part) to bonding surface of stud plate as shown in drawing no. BJ28-1. |
| 4. | Apply Beta Seal H.V.3. to bonding surface of stud plate as shown in drawing no. BJ28-1. |
| 5. | Fit stud plate to front surface of front bulkhead and ensure a bond gap of 2mm. |
| 6. | Remove excess Beta Seal. |
| 7. | Leave for 16 hour to all Beta Seal to cure. |
| 8. | Fit steering column infill gasket to stud plate studs from rear of front bulkhead. |
| 9. | Fit steering column infill to steering column infill gasket. and stud plate studs. |
| 10. | Secure steering column infill and grommet to studs with 4 nuts. |

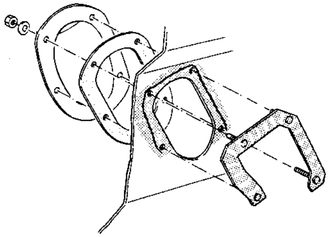
**Note:** Panel can only be fitted after intermediate steering column is connected to rack.

## Drawing No. BJ28-1 Steering Column Infill Bonding

KEY

▨ BETAWIPE, BETAPRIME

—— BETASEAL

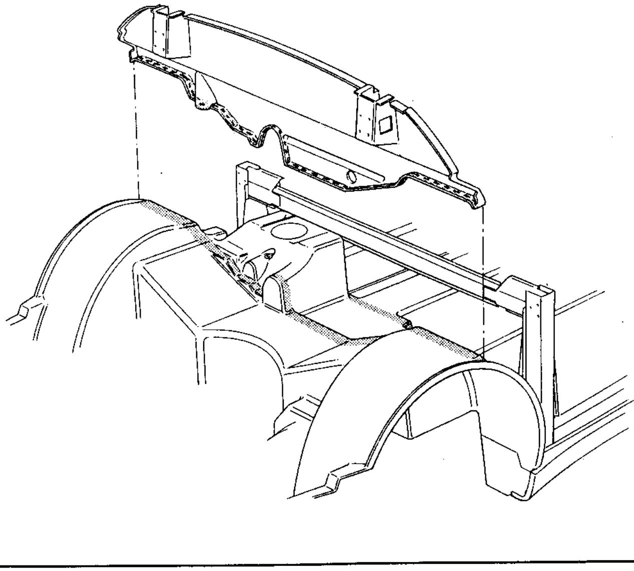


## Drawing No. BJ29-1 Rear Bulkhead Bonding

KEY

▨ BETAWIPE, BETAPRIME

—— BETASEAL



## BJ.29 - FIT REAR BULKHEAD

**Components**

Rear Bulkhead

**Adhesives**

Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tools**

Jig T000F0711
8mm Bolts
8mm Washers
Fibre Tip marker
Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Position jig to both 'B' posts and secure with 4 bolts. |
| 2. | Position rear bulkhead to jig and undertray. |
| 3. | Using fibre tip marker draw position of rear bulkhead of undertray. |
| 4. | Remove undertray. |
| 5. | Apply Beta Wipe 3900 to clean bonding surfaces of rear bulkhead and undertray as shown in drawing no. BJ29-1. |
| 6. | Apply Beta Prime 5402 to bonding surfaces or undertray as shown in drawing no. BJ29-1. |
| 7. | Apply Beta Seal H.V.3. to bonding surfaces of bulkhead as shown in drawing no. BJ29-1. |
| 8. | Refit rear bulk head to undertray and secure with 8mm bolts and washers - ensure a bond gap of 2mm. |
| 9. | Remove excess Beta Seal from all joints. |
| 10. | Leave jig secured to assembly for 16 hours to allow Beta Seal to cure. |
| 11. | Remove 8mm bolts and washers. |
| 12. | Remove bolts from jig. |
| 13. | Remove jig. |

## BJ.30 - FIT 'B' POST DIAPHRAGM

**Components**

'B' Post Diaphragm
2 x 8mm Rivnuts
2 x 8mm Bolts
2 x 8mm Washers

| | |
|---|---|
| Bobbin - Male 12mm | AX75B2676F |
| Bobbin - Female 12mm | AX75B2254F |

**Adhesives**

Beta Clean 3900
Beta Prime 5402
Beta Seal H.V.3.
Araldite 2002 (2 Part)

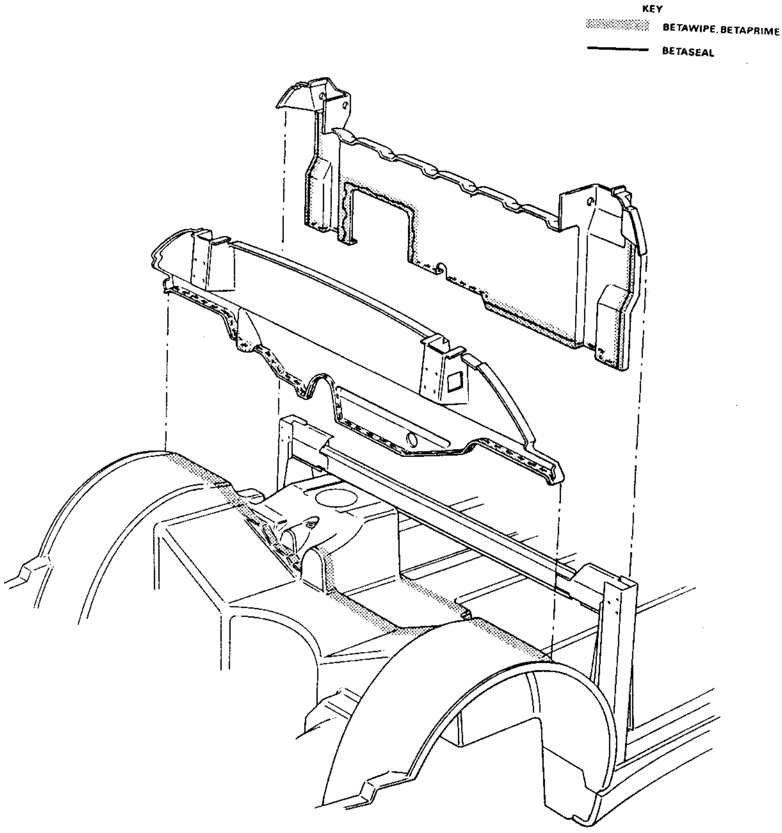
**Special Tools**

Bobbin Crimping Tool TOOOT1078
Araldite Nozzle
G. Clamps
Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Place 2 part Araldite around male & female parts of bobbin using Araldite nozzle. |
| 2. | Place male part of bobbin through appropriate hole in 'B' post diaphragm ensuring flat side is correctly positioned to act as bearing surface. |
| 3. | Fit female part of bobbin to male part and crimp end of male part using crimping tool. |
| 4. | Remove excess Araldite from joints. |
| 5. | Allow 15 hours for glue to cure. |
| 6. | Apply Beta Clean 3900 to clean bonding surfaces of 'B' post diaphragm, outriggers, 'B' posts, 'B' post cross brace and undertray as shown in drawing no. BJ30-1. |
| 7. | Apply Beta Clean 5402 to bonding surfaces of 'B' post diaphragm, outriggers, 'B' posts, 'B' post cross brace and undertray as shown in drawing no. BJ30-1. |
| 8. | Apply Beta Seal H.V.3. to bonding surfaces of 'B' post diaphragm as shown in drawing no. BJ30-1. |
| 9. | Position 'B' post diaphragm to undertray, 'B' posts cross brace and outriggers ensuring bond gap is 2mm and diaphragm mounting holes line up. |
| 10. | Fit G clamps along top edge & secure. |

| Op. No. | Notes |
|---|---|
| 11. | Remove excess Beta Seal from all joints. |
| 12. | Leave for 16 hours to allow Beta Seal to cure. |
| 13. | Remove G clamps. |

**Drawing No. BJ30-1 'B' Post Diaphragm Bonding**


KEY
▨ BETAWIPE. BETAPRIME
— BETASEAL

## BJ.31 - FIT SILL INFILL AND SILL

**Components**

| | |
|---|---|
| Rocker (Sill) Infill | R.H./L.H. |
| Rocker (Sill) | R.H./L.H. |

**Adhesives**

Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

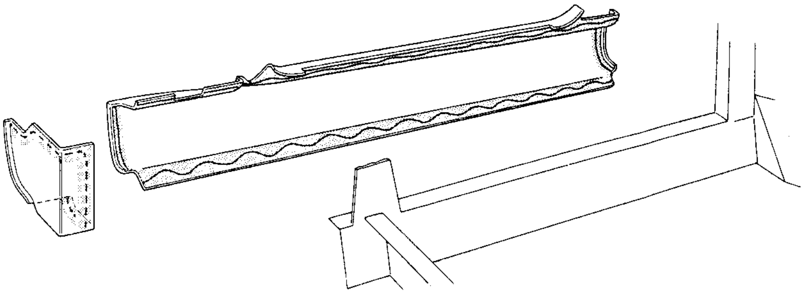
**Special Tools**

Beta Seal Dispenser and Nozzle
Jig T000F0710

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of sill infill and undertray as shown in drawing no. BJ31-1. |
| 2. | Apply Beta Primer 5402 to bonding surfaces of sill infill and undertray as shown in drawing no. BJ31-1. |
| 3. | Apply Beta Seal H.V.3. to bonding surface of sill infill as shown in drawing no. BJ31-1. |
| 4. | Fit sill infill to undertray. |
| 5. | Apply Beta Wipe 3900 to clean bonding surfaces of sill, sill infill, undertray and outrigger as shown in drawing no. BJ31-1. |
| 6. | Apply Beta Primer 5402 to bonding surfaces of sill, sill infill, undertray and outrigger as shown in drawing no. BJ31-1. |
| 7. | Apply Beta Seal H.V.3. to bonding surface of sill as shown in drawing no. BJ31-1. |
| 8. | Fit sill to sill infill, undertray and outrigger and ensure bond gap is 2mm and fill holes with Beta Seal H.V.3. as shown in drawing no. BJ31-2. |
| 9. | Fit jig to secure sill and sill infill. |
| 10. | Remove excess Beta Seal from joints. |
| 11. | Leave for 16 hours to allow Beta Seal to cure. |
| 12. | Remove jig. |

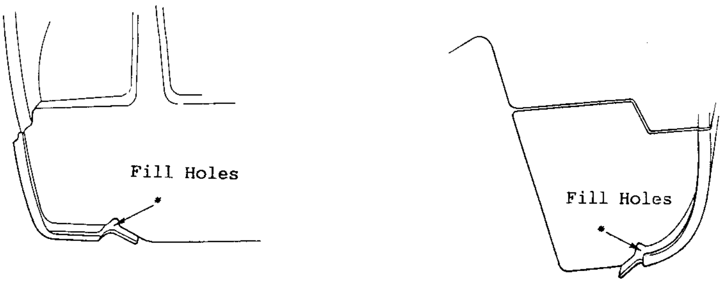
Drawing No. BJ31-1 Sill and Sill Infill Bonding

KEY
▨ BETAWIPE. BETAPRIME
— BETASEAL



Drawing No. BJ31-2 Sill and Sill Infill Bonding

KEY
▨ BETAWIPE. BETAPRIME
— BETASEAL



## BJ.32 - FIT 'A' POST COVER

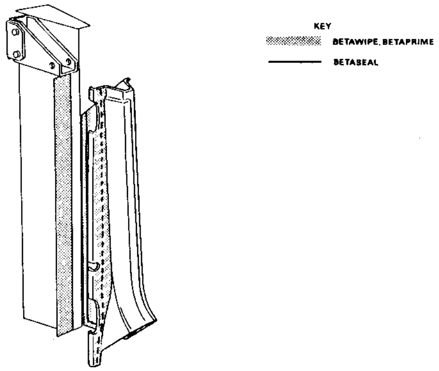
**Components**
'A' Post Cover L.H./R.H.

**Adhesives**
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tool**
Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of 'A' post cover, 'A' post, front bulkhead and sill as shown in drawing no. BJ32-1. |
| 2. | Apply Beta Prime 5402 to bonding surface of 'A' post cover, 'A' post, front bulkhead and sill as shown in drawing no. BJ32-1. |
| 3. | Apply Beta Seal H.V.3. to bonding surface of 'A' post cover as shown in drawing no. BJ32-1. |
| 4. | Position 'A' post cover to 'A' post, front bulkhead and sill and ensure bond gap is 2mm. |
| 5. | Remove excess Beta Seal from joints. |
| 6. | Leave for 16 hours to allow Beta seal to cure. |

**Drawing No. BJ32-1 'A' Post Cover Bonding**



## BJ.33 - FIT 'B' POST COVER

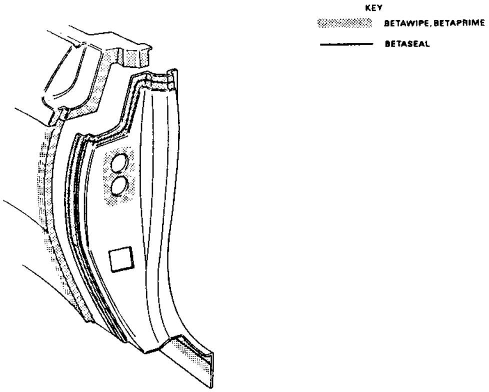
**Components**
'B' Post Cover R.H./L.H.

**Adhesives**
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tools**
Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of 'B' post cover, 'B' post, diaphragm, outrigger and sill as shown in drawing no. BJ33-1. |
| 2. | Apply Beta Prime 5402 to bonding surfaces of 'B' post cover, 'B' post diaphragm, outrigger and sill as shown in drawing no. BJ33-1. |
| 3. | Apply Beta Seal H.V.3. to bonding surfaces of 'B' post cover as shown in drawing no. BJ33-1. |
| 4. | Position 'B' post cover to 'B' post, 'B' post diaphragm, outrigger and sill ensuring bond gap is 2mm. |
| 5. | Remove excess Beta Seal from joints. |
| 6. | Leave for 16 hours to allow Beta seal to cure. |

**Drawing No. BJ33-1 'B' Post Cover Bonding**



## BJ.34 - FIT REAR QUARTER LOWER R.H./L.H

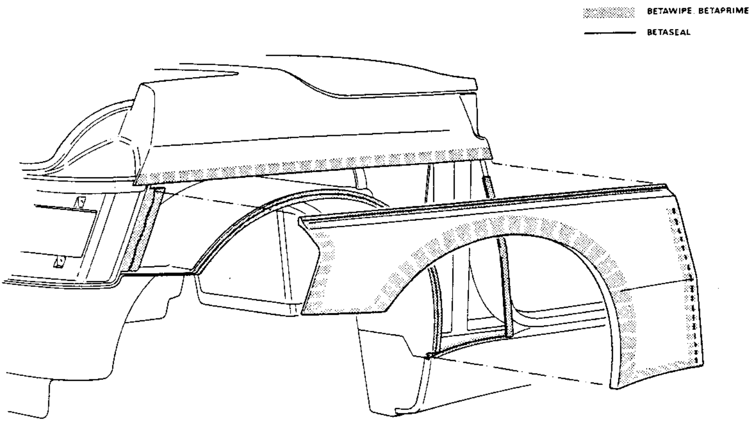
**Components**
Rear Lower Quarter

**Adhesives**
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

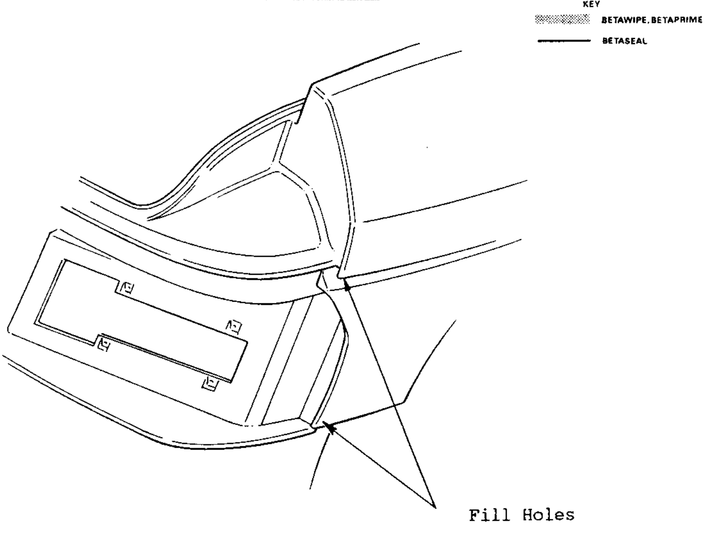
**Special Tools**
Jig TOOOF0710
Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of rear lower quarter panel, 'B' post cover, undertray, rear bulkhead and sill as shown in drawing no. BJ34-1. |
| 2. | Apply Beta Prime 5402 to bonding surfaces of rear lower quarter panel, 'B' post cover, undertray, rear bulkhead and sill as shown in drawing no. BJ34-1. |
| 3. | Apply Beta Seal H.V.3. to bonding surfaces of rear lower quarter panel as shown in drawing no. BJ34-1. |
| 4. | Position rear lower quarter panel to 'B' post cover, undertray, and sill, ensure bond gap is 2mm and fill holes with Beta Seal H.V.3. as shown in drawing no. BJ34-2. |
| 5. | Fit jig to secure lower quarter panel. |
| 6. | Remove excess Beta Seal. |
| 7. | Leave for 16 hours to allow Beta Seal to cure. |
| 8. | Remove jig. |

Drawing No. BJ34-1 Rear Lower Quarter Bonding


KEY
▒ BETAWIPE. BETAPRIME
— BETASEAL

Drawing No. BJ34-2 Rear Lower Quarter Bonding


KEY
▒ BETAWIPE, BETAPRIME
— BETASEAL
Fill Holes

## BJ35 - FIT REAR TRANSOM

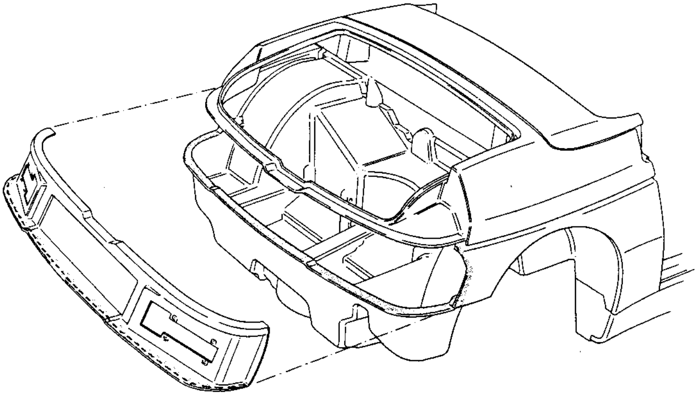
**Components**
Rear Transom

**Adhesives**
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tools**
Beta Seal Dispenser and Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of rear transom, lower quarter panels & undertray as shown in drawing no. BJ35-1. |
| 2. | Apply Beta Prime 5402 to clean bonding surfaces of rear transom, lower quarter panels and undertray as shown in drawing no. BJ35-1. |
| 3. | Apply Beta Seal H.V.3. to bonding surfaces of rear transom as shown in drawing no. BJ35-1. |
| 4. | Position rear transom to undertray and lower quarter panels, and ensure a bond gap of 2mm. |
| 5. | Remove excess Beta Seal from all joints. |
| 6. | Leave 16 hours to allow Beta Seal to cure. |

Drawing No. BJ-35-1 Rear Transom Bonding



## BJ.36 FIT REAR TOP SHELL

**Components**
Rear Top Shell

**Adhesives**
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tools**
Jig T000F0710
Beta Seal Dispenser & Nozzle

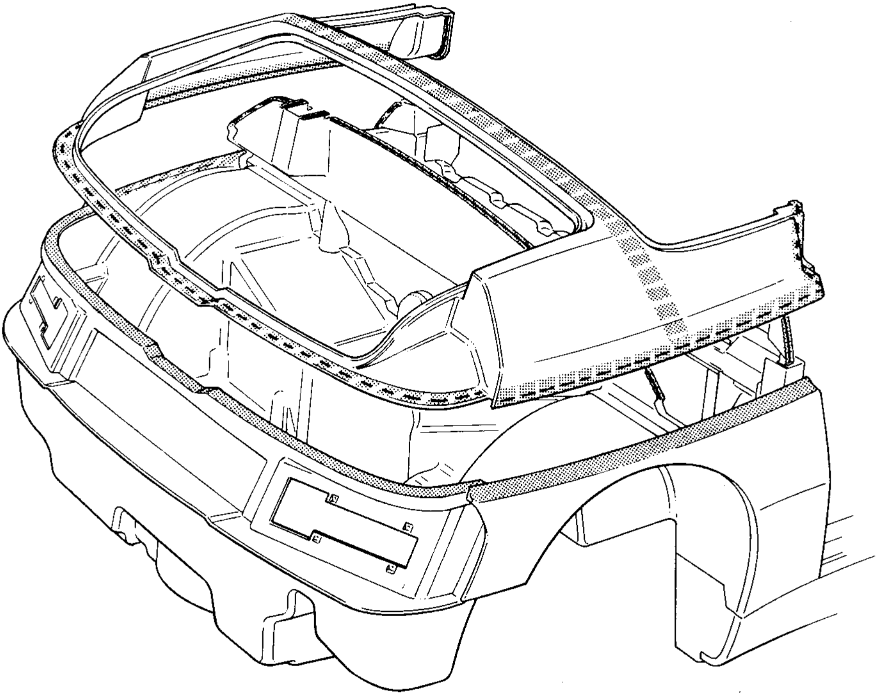
| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of rear top shell, 'B' post covers, 'B' post diaphragm, lower quarter rear panels and rear transom as shown in drawing no. BJ36-1. |
| 2. | Apply Beta Prime 5402 to bearing surfaces of rear top shell, 'B' post covers, 'B' post diaphragm, lower quarter panels and rear transom as shown in drawing no. BJ36-1. |
| 3. | Apply Beta Seal H.V.3. to bearing surface of rear top shell as shown in drawing no. BJ36-1. |
| 4. | Position rear top shell to 'B' post cover, 'B' post diaphragm, lower quarter panels and rear transom - ensure 2mm bond gap. |
| 5. | Fit jig to ensure rear panels are correctly positioned. |
| 6. | Remove excess Beta Seal from all joints. |
| 7. | Leave 16 hours to allow 16 hours for Beta Seal to cure. |
| 8. | Remove jig. |

## Drawing No. BJ36-1 Rear Top Shell Bonding

KEY

▒ BETAWIPE, BETAPRIME

—— BETASEAL



## BJ.37 - FIT FUEL FILLER REBATE

**Components**

Fuel filler rebate

**Adhesives**

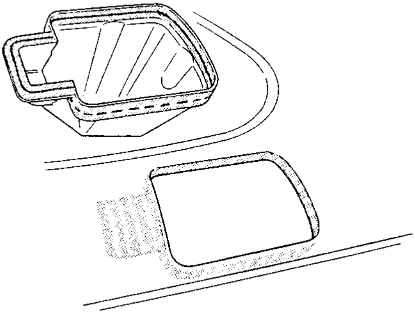
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tools**

Beta Seal dispenser and nozzle
Tape

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of fuel filler rebate and rear top shell as shown in drawing no. BJ37-1. |
| 2. | Apply Beta Prime 5402 to bonding surfaces of fuel filler rebate and rear top shell as shown in drawing no. BJ37-1. |
| 3. | Apply Beta Seal H.V.3. to bonding surface of fuel filler rebate as shown in drawing no. BJ37-1. |
| 4. | Position fuel filler rebate to top shell and ensure a bond gap of 2mm. |
| 5. | Secure fuel filler rebate to rear top shell using tape. |
| 6. | Remove excess Beta Seal from joints. |
| 7. | Leave for 16 hours to allow Beta Seal to cure. |
| 8. | Remove tape. |

**Drawing No. BJ37-1 Fuel Filler Rebate Bonding**



## BJ.38 - FIT BATTERY TRAY TO UNDERTRAY

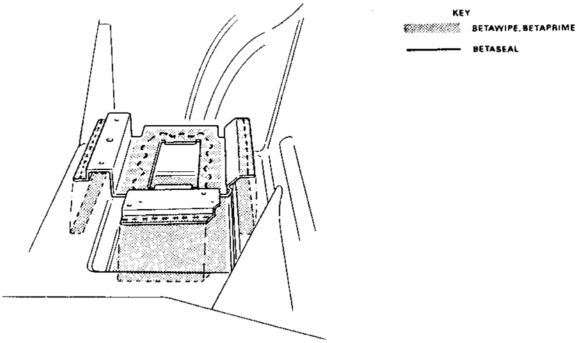
**Components**
Battery Tray

**Adhesive**
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tools**
Weights
Beta Seal Dispenser & Nozzle

| Op. No. | Notes |
|---|---|
| 1. | Apply Beta Wipe 3900 to clean bonding surfaces of battery tray recess in undertray and battery tray as shown in drawing no. BJ38-1. |
| 2. | Apply Beta Prime 5402 to bonding surfaces of battery tray recess in undertray and battery tray as shown in drawing no. BJ38-1. |
| 3. | Apply Beta seal H.V.3. to bonding surface of battery tray as shown in drawing no. BJ38-1. |
| 4. | Position battery tray to battery tray recess ensuring bond gap is 2mm & rear and side upright surfaces of battery tray are in contact with battery tray recess in undertray. |
| 5. | Place weights on battery tray to secure. |
| 6. | Remove excess Beta Seal from joints. |
| 7. | Leave for 16 hours to allow Beta Seal to cure. |
| 8. | Remove weights. |

Drawing No. BJ38-1 Battery Tray Bonding



## BJ.39 - FIT FUEL STRAP MOUNTING STRENGTHENING BRACKET

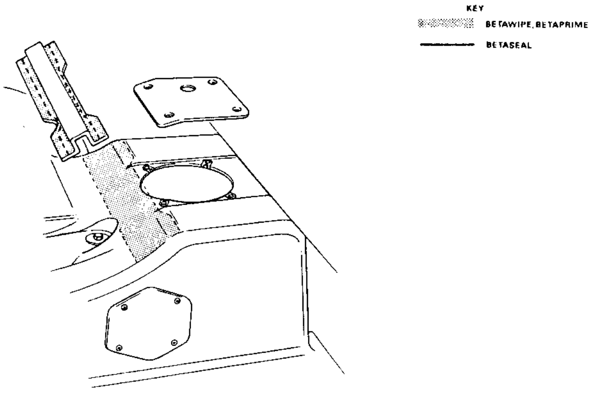
**Components**
Fuel Strap Mounting Strengthening Bracket

**Adhesives**
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

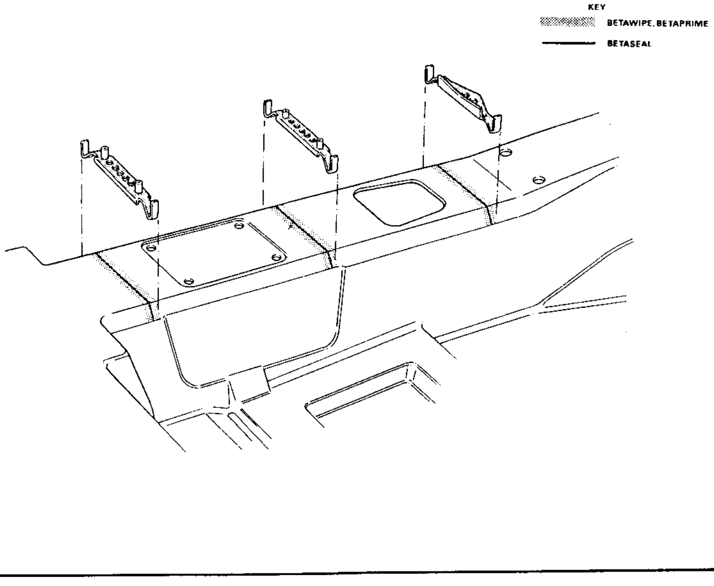
**Special Tools**
Brush
Beta Seal Dispenser & Nozzle
Weights
Fibre Tip Marker

| Op. No. | Notes |
|---|---|
| 1. | Ensure pump cover is fitted to undertray. |
| 2. | Position fuel strap mounting strengthening brkt so that pump the cover may be removed and access obtained to the bobbin at rear of fuel strap mounting strengthening. |
| 3. | Using fibre tip marker draw line around fuel strap mounting strengthening bracket to ascertain its correct position. |
| 4. | Remove fuel strap mounting strengthening bracket. |
| 5. | Apply Beta Wipe 3900 to clean bonding surfaces of fuel strap mounting strengthening bracket and undertray as shown in drawing no. BJ39-1. |
| 6. | Apply Beta Prime 5402 to bonding surfaces of fuel strap mounting strengthening bracket and undertray as shown in no. BJ39-1. |
| 7. | Apply Beta Seal H.V.3.to bonding surfaces of fuel strap mounting strengthening bracket as shown in drawing no. BJ39-1. |
| 8. | Position fuel strap mounting strengthening bracket to undertray - ensure 2mm bond gap and freedom of access to bobbin and fuel pump cover. |
| 9. | Place weight on fuel strap mounting strengthening bracket to secure. |
| 10. | Remove excess Beta Seal from joints. |
| 11. | Allow 16 hours for Beta Seal to cure. |
| 12. | Remove weights. |

## Drawing No. BJ-39-1 Fuel Strap Mounting Bracket Bonding


KEY
▨ BETAWIPE, BETAPRIME
— BETASEAL

## Drawing No. BJ40-1 Centre Consul Mounting Brackets Bonding


KEY
▨ BETAWIPE, BETAPRIME
— BETASEAL

## BJ.40 - FIT 3 CENTRE CONSUL MOUNTING BRACKETS

**Components**

| | |
|---|---|
| Bracket Facia | 1 off A100B0136 |
| Bracket Consul | 2 off A100B0228 |

**Adhesives**

Beta Wipe 3900
Beta Prime 2 Part (VP01706A and VP01706B)
Beta Prime 5400
Beta Seal H.V.3.

**Special Tools**

Marker
Beta Seal Dispenser and Nozzle
Jig TOOOF0712

| Op. No. | Notes |
|---|---|
| 1. | Place jig over gear lever aperture on undertray tunnel. |
| 2. | Mark position of brackets using fibre tip marker. |
| 3. | Remove jig. |
| 4. | Apply Beta Wipe 3900 to clean bonding surfaces of brackets and tunnel as shown in drawing no. BJ40-1. |
| 5. | Apply Beta Prime (2 part) to bonding surfaces of metal brackets as shown in drawing no. BJ40-1. |
| 6. | Apply Beta Prime 5402 to bonding surfaces of tunnel as shown in drawing no. BJ40-1. |
| 7. | Apply Beta Seal H.V.3. to brackets as shown in drawing no. BJ40-1. |
| 8. | Fit single bracket to front position - fit pair of brackets to rear positions. |
| 9. | Ensure bond gap is 2mm. |
| 10. | Remove excess Beta Seal from joints. |
| 11. | Leave 16 hours to allow Beta Seal to cure. |

## BJ.41 - INTRODUCTION TO UNDERTRAY REPAIRS

The following is an introduction to the undertray repairs.

The repair of the undertray provides the largest, most detailed and time consuming work carried out on the G.F.R.P. and for safety reasons it is also the most important.

Each of the following sections contain detailed repair procedures plus lists of components, materials, adhesives and special tools which will be required to complete the task.

It is recommended that a careful study be made of the procedures, components, materials, adhesives, tools and drawings before commencing the repair.

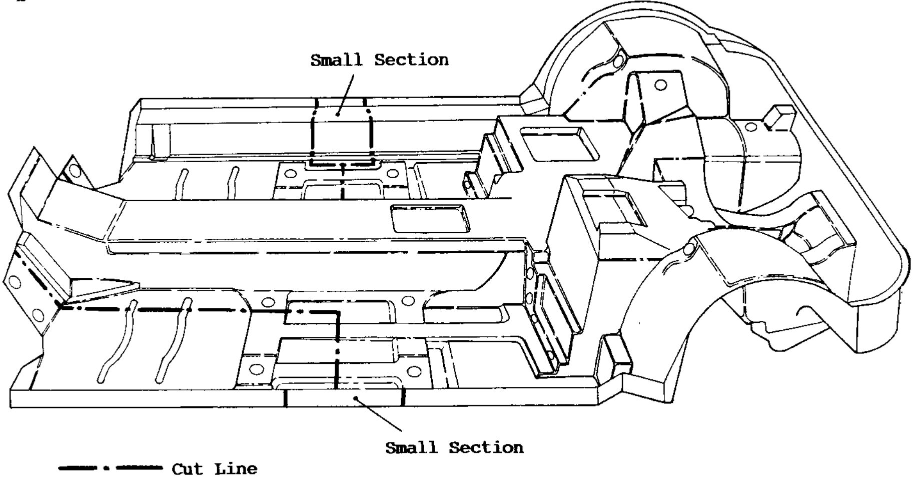
In many instances it will be necessary to remove panels and chassis from the body before repairing the undertray.

When removing and replacing half an outrigger it is important to position the cut in exactly the correct position (see outrigger drawing).

The outrigger strengthening plate will be provided as a spare part.

## Drawing No. BJ42-1 Undertray - Front Quarter - Cut Lines

**Undertray Front Quarter Sections**



## BJ.42 - REMOVE FRONT QUARTER SECTION OF UNDERTRAY

**Component**

Front quarter section of undertray - comprising of:-

a) Front quarter section of undertray.
b) Front section of outrigger including 'A' post.
c) Side section of front bulkhead.
d) Front jacking point.

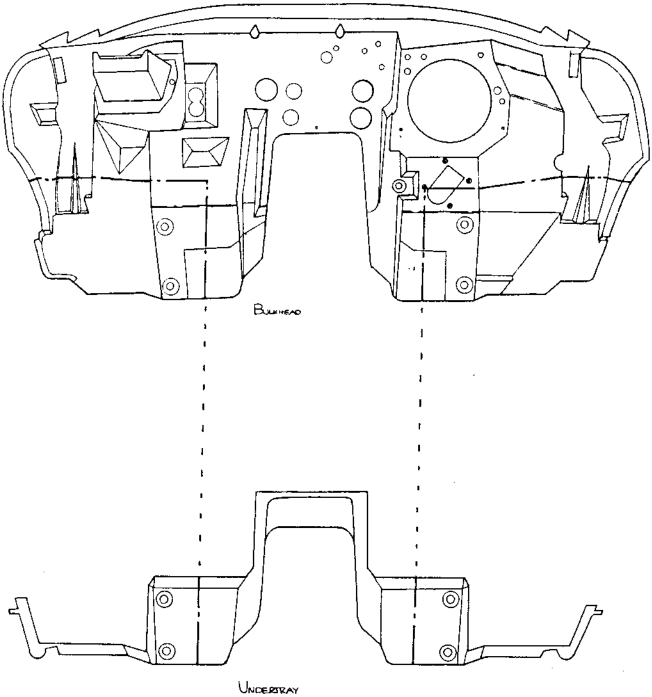
**Special Tools**

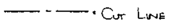
Saw
Grinder
Wire Set
Lotus Panel Tool T000T1077
Router
Marker
Welding Set

| Op. No. | Notes |
|---|---|
| 1. | Remove the seats and floor coverings. |
| 2. | Remove the dash board. |
| 3. | Remove the four bolts from the 'A' posts which secure the windscreen frame. |
| 4. | Cut the adhesive between the windscreen and windscreen landing using the wire set. |
| 5. | Remove the windscreen and frame and place aside. |
| 6. | Remove the 'A' post cover - rout down the centre of the 'A' post cover and remove the pieces using the Lotus panel tool. |
| 7. | Mark the undertray as shown in drawing no. BJ42-1 and 2. |
| 8. | Remove the two bolts which secure the toe board to the chassis. |
| 9. | Ensure that the scuttle beam is disconnected from the relevant 'A' post. |
| 10. | Cut the undertray along the marked line using a router and saw as necessary. |
| 11. | Cut the adhesive on the top of the 'A' post and underneath of the windscreen landing. |
| 12. | Cut the adhesive on the 'A' post and bulk head. |

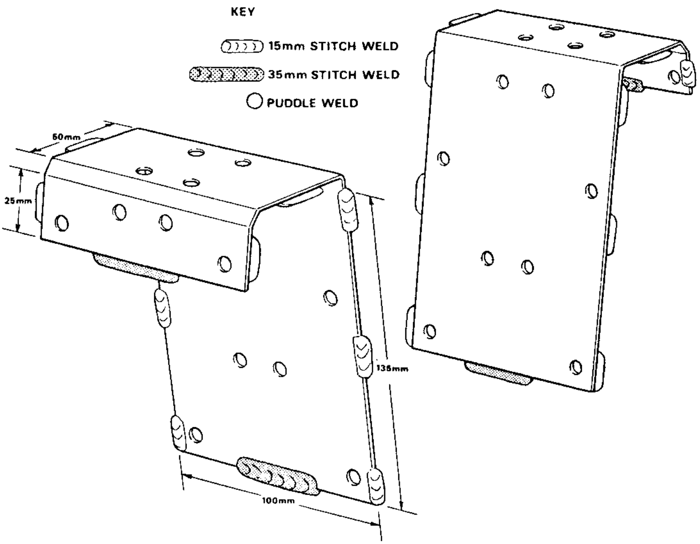
| Op. No. | Notes |
|---|---|
| 13. | Using a saw cut the outrigger as shown in drawing no. BJ42-4. |
| 14. | Remove and discard damaged front section of undertray, bulk head and outrigger. |

Drawing No. BJ42-2 Front Bulkhead - Front Quarter - Cut Lines


Bulkhead
Undertray

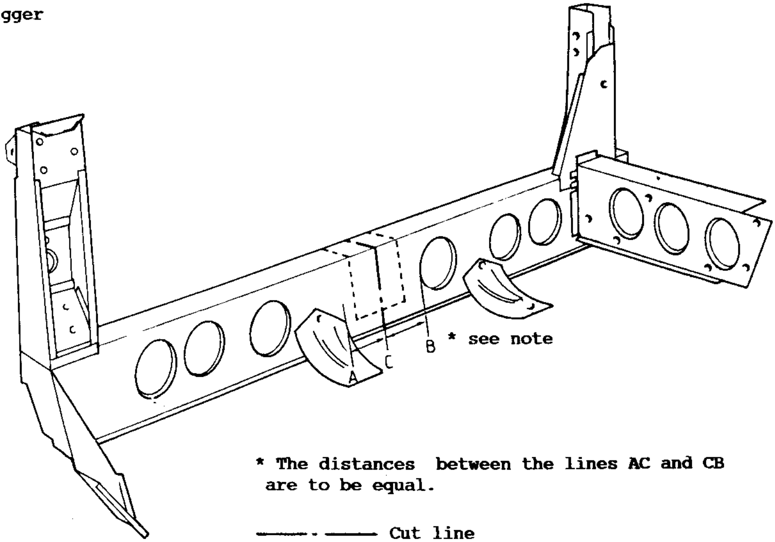


## Drawing No. BJ42-3 Outrigger Strengthening Section


KEY
15mm STITCH WELD
35mm STITCH WELD
PUDDLE WELD
60mm
25mm
135mm
100mm

## Drawing No. BJ42-4 Outrigger - Cut Line and Strengthening Section

Outrigger


A
C
B
* see note

* The distances between the lines AC and CB are to be equal.

——— - ——— Cut line

- - - - - - - - - Backing plate

## REFIT QUARTER FRONT SECTION OF UNDERTRAY

**Components**

Front section of undertray comprising of:-

a) Front quarter section of undertray.
b) Front section of undertray including 'A' post.
c) Side section of bulkhead.
d) Front jacking point.
**Note:-** All the above supplied as one section

Outrigger strengthening section.
1/4" Pop Rivets
1/4" Imex Pop Rivets
Washers

**Materials**

1½oz. C.S.M. (chopped strand mat)
Resin
Continuous length roving
Woven glass cloth 300 grams per metre squared
Acetone
Two Part Primer (Beta Prime VP01706 A and B)
Wax Spray

**Adhesives**

Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

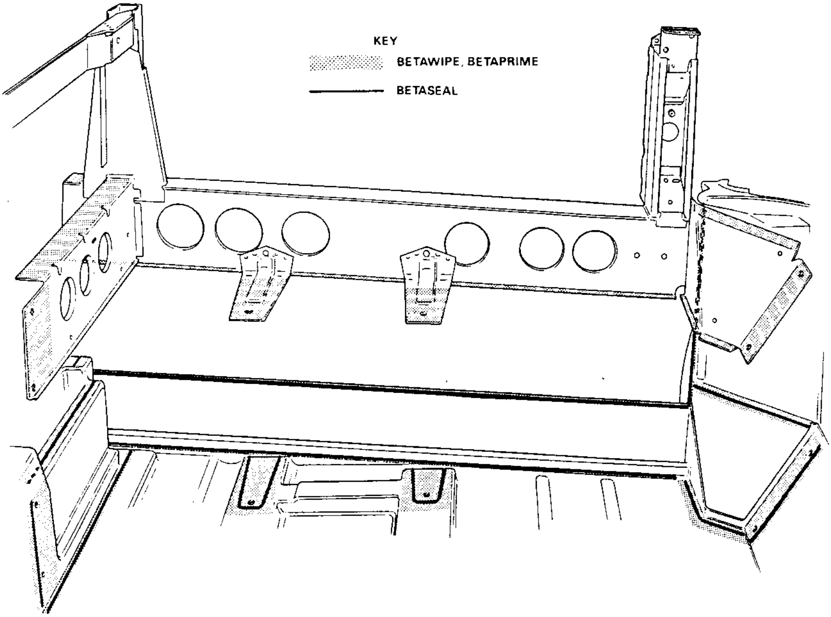
**Special Tools**

Jig T000F0710
Marker
Saw
36 Grit Paper and Mechanical Sander
Plates
Wax Spray Equipment
Pop Riveter
Beta Seal Dispenser and Nozzle
Welder

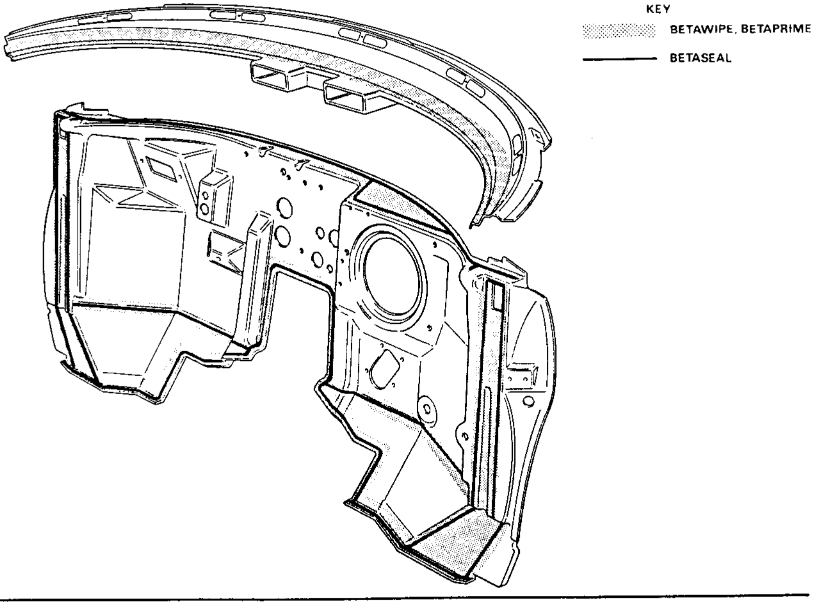
| Op. No. | Notes |
|---|---|
| 1. | Cut new section of undertray, outrigger and front bulkhead to suit area to be repaired. |
| 2. | Position jig to car. |
| 3. | Position new front section to jig and undertray. |
| 4. | Ensure new front section fits undertray, outrigger, front bulk and jig accurately i.e. a gap of 1/8" to 1/4" (3mm to 6mm) should be maintained between both parts of the bulkhead and undertray while ensuring that the jig fits comfortably in the "pick up" and datum points. |

| Op. No | Notes |
|---|---|
| 5. | Remove the new front section from the jig and using a 36 grit paper and mechanical sander, clean a "6" strip on both surfaces of both panel edges to be laminated, feathering outwards from the joint line. |
| 6. | Using a 36 grit paper and mechanical sander remove all old Beta Seal from the undertray, front bulkhead and underneath corner of windscreen landing. |
| 7. | Ensure that area to be bonded is free from dust. |
| 8. | Wipe bonding surfaces of bulkhead, 'A' post and underneath corner of windscreen landing with Beta Wipe 3900 as shown in drawing no. BJ42-5 & 6. |
| 9. | Apply Beta Prime 5402 to bonding surfaces bulkhead, 'A' post and underneath corner of windscreen landing as shown in drawing no. BJ42-5 & 6. |
| 10. | Apply Beta Seal H.V.3. to bonding surfaces of 'A' post front and top as shown in drawing no. BJ42-5 & 6. |
| 11. | Ensure new front section fits under tray, outrigger, front bulkhead and jig accurately i.e. a gap of 1/8" to 1/4" (3mm to 6mm) should be maintained between both parts of the undertray, bulkhead and outrigger while ensuring that the jig fits comfortably in the "pick up" and datum points. |
| 12. | Position, drill and pop rivet the plates to the new front section and the undertray as necessary. |
| 13. | Ensure that the area to be laminated is free from dust. |
| 14. | Wipe sanded area with acetone. |
| 15. | Brush resin onto underneath of joint. |
| 16. | Apply two layers of resin impregnated 1½oz. chopped strand mat to underside of joint - roll and tamp down. |
| 17. | Allow resin to cure at a temperature of not less than 15°C. |
| 18. | When joint on underneath has fully cured, drill out pop rivets and remove plates from top. |
| 19. | Ensure area to be laminated is free from dust. |
| 20. | Wipe sanded area with acetone. |

## Drawing No. BJ42-5 Outrigger Bonding


KEY
▨ BETAWIPE, BETAPRIME
——— BETASEAL

## Drawing No. BJ42-6 Front Bulkhead Bonding


KEY
▨ BETAWIPE, BETAPRIME
——— BETASEAL

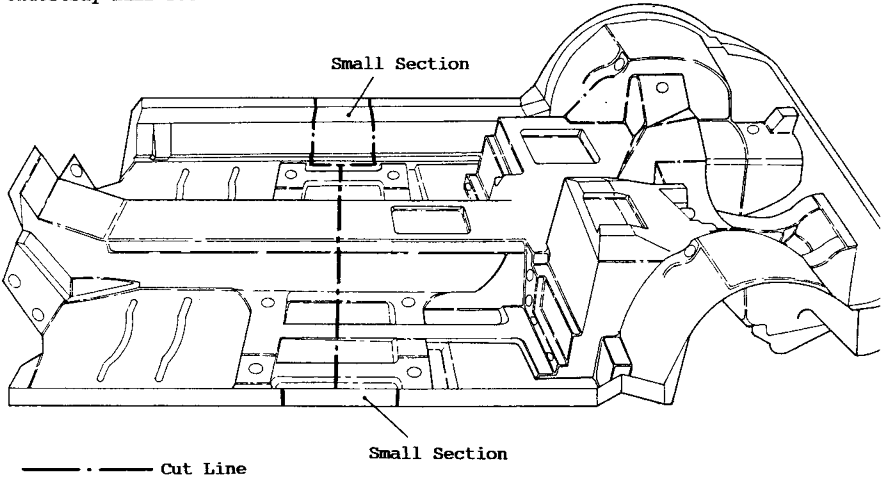
| Op. No. | Notes |
|---|---|
| 21. | Apply resin to the continuous length roving and insert into joint. |
| 22. | Brush resin onto top of joint. |
| 23. | Apply one layer of resin impregnated 1½oz. chopped strand mat to the top of the joint - roll and tamp down. |
| 24. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre squared to the top of the joint - roll and tamp down. |
| 25. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of the joint - roll and tamp down. |
| 26. | Allow resin to cure at a temperature of not less than 15°C. |
| 27. | Cut a small section of the fibreglass undertray away from the outrigger to be welded as shown in drawing no. BJ42-1. |
| 28. | Ensure a gap of 1/8" to 1/4" (3mm to 6mm) is maintained between both sections of the outrigger, while the "pick up" and datum points fit comfortably on the jig. Secure the two sections of the outrigger together. |
| 29. | Using a 36 grit paper and mechanical sander clean an area up to 2½" (65mm) either side of the joint on the outrigger and the strengthening section. |
| 30. | Position and secure the strengthening section to the underneath of the outrigger ensuring it fits centrally across the joint and the two sections of the outrigger align correctly with each other. |
| 31. | Ensure that the outer edge of the outrigger remains at an angle of 12° or more. |
| 32. | **Note:** For safety reasons ensure all flammable materials e.g. resin, acetone etc. are removed from the work area. Ensure that the area is free from dust and well ventilated. Ensure that the dust extraction equipment is cleaned regularly. |
| 33. | Puddle and stitch weld the strengthening section to the outrigger then secure the 'B' post cross brace and tie to the 'B' post. |
| 34. | Using a 36 grit paper and mechanical sander clean all welds and surrounding area. |
| 35. | Ensure that the area to be zinc primed is dust free. |
| 36. | Cover all sanded, welded and strengthening plate areas on both sides of the outrigger by painting with a two part zinc rich primer as per the manufacturer's instructions to provide anti corrosion protection for the outrigger. |

| Op. No. | Notes |
|---|---|
| 37. | Using 36 grit paper and mechanical sander remove all old Beta Seal from the outrigger and small section of the undertray. |
| 38. | Using 36 grit paper and mechanical sander clean both surfaces of both edges to be laminated, feathering outward from the joint line. |
| 39. | Ensure that the area to be bonded is free from dust. |
| 40. | Apply Beta Wipe 3900 to clean bonding surfaces of small section of undertray as shown in drawing no. BJ42-5. |
| 41. | Apply Beta Prime 5402 to bonding surfaces of small section undertray and outrigger as shown in drawing no. BJ42-5. |
| 42. | Apply Beta Seal H.V.3 to bonding surface of small section of undertray as shown in drawing no. BJ42-5. |
| 43. | Fit small section of undertray to outrigger and undertray and maintain a gap of 1/8" to 1/4" (3mm to 6mm) between small section and undertray. |
| 44. | Ensure a bond gap of 2mm between small section of undertray and outrigger. |
| 45. | Position drill and pop rivet the plates to the small section of the undertray and undertray. |
| 46. | Ensure area to be laminated is free from dust. |
| 47. | Wipe sanded area with acetone. |
| 48. | Brush resin onto underneath of the joint. |
| 49. | Apply two layers of resin impregnated 1½oz. chopped strand mat to the underneath of the joint - roll and tamp down. |
| 50. | Allow resin to cure at a temperature of not less than 15°C. |
| 51. | When the joint has cured, drill out the pop rivets and remove the plates. |
| 52. | Ensure area to be laminated is free from dust. |
| 53. | Wipe sanded area with acetone. |
| 54. | Apply resin to continuous length roving and insert into joint. |
| 55. | Brush resin onto top of joint. |

| Op. No. | Notes |
|---|---|
| 56. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll & tamp down. |
| 57. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre squared to top of joint - roll and tamp down. |
| 58. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll & tamp down. |
| 59. | Allow resin to cure at at temperature of not less than 15°C. |
| 60. | Drill and fit 1/4" pop rivets and washers to outside edge of undertray outrigger. |
| 61. | Drill and fit 1/4" Imex pop rivets and washers to inside edge of undertray and outrigger. |
| 62. | Apply wax film to all surfaces of outrigger both inside and outside as per wax film manufacturers instruction. |

## Drawing No. BJ43-1 Undertray - Front Half - Cut Lines

**Undertray Half Section**



## BJ.43 - REMOVE FRONT HALF SECTION

**Components**

Front half section comprising of:-

a) Front Half of Undertray
b) Front Half of Both Outriggers Including 'A' Posts
c) Front Bulk Head
d) Demister Duct
e) Both Front Jacking Points

**Special Tools**

Saw
Router
Marker
Wire Set
Lotus Panel Tool T000T1077

| Op. No | Notes |
|---|---|
| 1. | Remove the body from the chassis. |
| 2. | Remove all components from the front bulk head. |
| 3 | Remove the four bolts from the 'A' posts which secure the windscreen frame. |
| 4. | Cut the adhesive between the windscreen and windscreen landing using the wire set. |
| 5. | Remove the windscreen frame and place aside. |
| 6. | Remove the scuttle beam. |
| 7. | Remove the seats, floor covering and all components attached to the front section of the undertray. |
| 8. | Remove the 'A' post cover - rout down the centre of the 'A' post covers and remove the pieces using the Lotus panel tool. |
| 9. | Mark the undertray and outriggers as shown in drawing no. BJ43-1 and 3. |
| 10. | Cut the outriggers and undertray along the marked cut line using a saw and router as necessary. |
| 11. | Remove and discard damaged front section. |

## REFIT FRONT HALF SECTION OF UNDERTRAY

**Components**

Front half section of undertray comprising of:

a) Front Half Section of Undertray
b) Bulk head
c) Demister Duct
d) Both Front Sections of Outriggers
e) Both Front Jacking Points
**Note:** All the above supplied as one section

Outrigger Strengthening Sections
1/4" Pop Rivets
1/4" Imex Pop Rivets
Washers

**Materials**

Resin
1½"oz. C.S.M. (Chopped Strand Mat)
Woven glass cloth 300 grams per metre squared
Continuous length roving
Acetone
2 Part primer (Beta Prime VP01706A and B)
Wax Spray

**Adhesives**

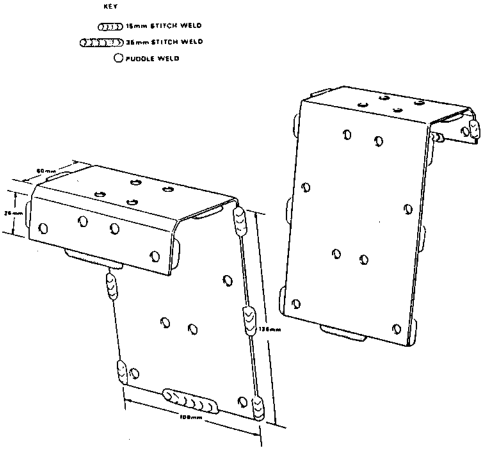
Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3

**Special Tools**

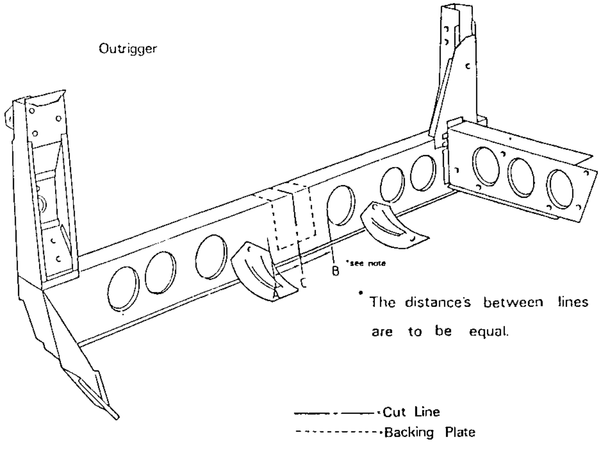
Saw
Router
36 Grit Paper and Mechanical Sander
Jig T000F0710
Brackets
Welding Set
Lotus Panel Tool T000T1077
Wire Set
Beta Seal Dispenser and Nozzle
Wax Spray Equipment

| Op. No. | Notes |
|---|---|
| 1. | Cut new section of undertray and outriggers to suit area to be repaired as shown in drawing no. BJ43-1 & 3. |
| 2. | Position jig to car. |
| 3. | Position new section to jig and undertray. |

## Drawing No. BJ43-2 Outrigger Strengthening Section


KEY
15mm STITCH WELD
35mm STITCH WELD
PUDDLE WELD
60mm
25mm
135mm
100mm

## Drawing No. BJ43-3 Outrigger - Cut Line and Strengthening Section


Outrigger
C
B
*see note
——-——Cut Line
-----------Backing Plate

* The distance's between lines AC and CB are to be equal.

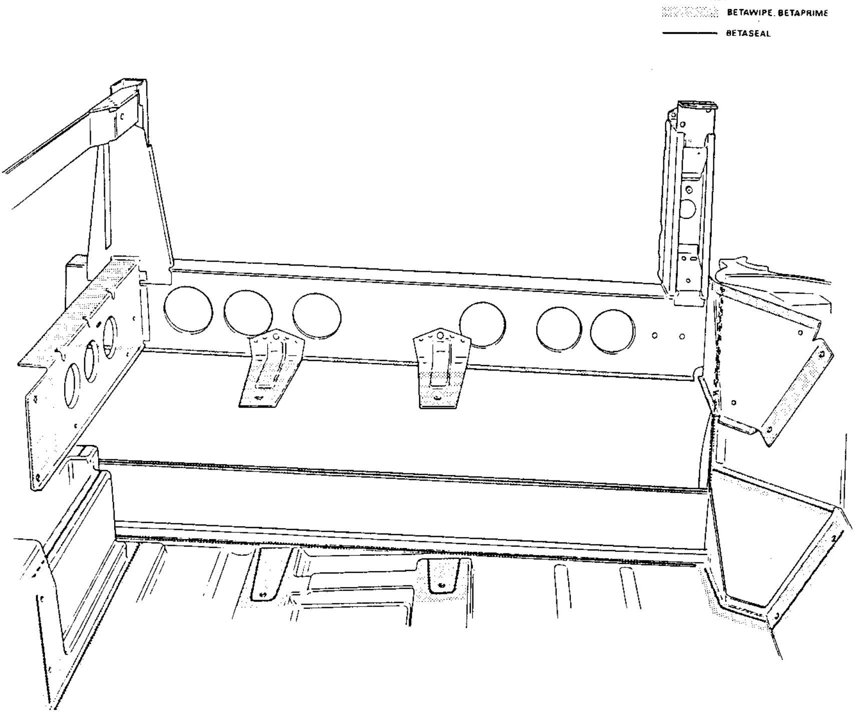
| Op. No. | Notes |
|---|---|
| 4. | Ensure new section fits undertray, outrigger and jig accurately, i.e. a gap of 1/8" to 1/4" (3mm to 6mm) should be maintained between both parts of the undertray and outriggers, while ensuring that the jig fits comfortably in the "pick up" and datum points. |
| 5. | Remove the new section from the jig and using a 36 grit paper and mechanical sander, clean a "6" strip on both surfaces of both panel edges to be laminated, feathering outwards from the joint line. |
| 6. | Refit the new section to the undertray, outrigger and jig accurately i.e. a gap of 1/8" to 1/4" (3mm to 6mm) should be maintained between both parts of the undertray and outriggers, while ensuring that the jig fits comfortably in the "pick up" and datum points. |
| 7. | Position, drill and pop rivet brackets to the new section and undertray as necessary. |
| 8. | Ensure that the area to be laminated is free from dust. |
| 9. | Wipe sanded area with acetone. |
| 10. | Brush resin onto underneath of joint. |
| 11. | Apply two layers of resin impregnated 1½oz. chopped strand mat to underneath of joint - roll and tamp down. |
| 12. | Allow resin to cure at a temperature of not less than 15°C. |
| 13. | When the joint underneath has fully cured drill out pop rivets and remove plates from top. |
| 14. | Ensure area to be laminated is free from dust. |
| 15. | Wipe sanded area with acetone. |
| 16. | Apply resin to continuous length roving and insert into joint. |
| 17. | Brush resin onto top of joint. |
| 18. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll and tamp down. |
| 19. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre square to top of joint - roll and tamp down. |
| 20. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll and tamp down. |

| Op. No. | Notes |
|---|---|
| 21 | Allow resin to cure at a temperature of not less than 15°C. |
| 22. | Cut small section of undertray away from the area to be welded as shown in drawing no. BJ43-1. |
| 23. | Ensure a gap of 1/8" to 1/4" (3mm to 6mm) is maintained between both sections of the outrigger, while the "pick up" and datum points fit comfortably on the jig. Secure the two sections of the outrigger together. |
| 24. | Using a 36 grit paper and mechanical sander clean an area up to 2½" (65mm) either side of the joint on the outriggers. |
| 25. | Using a 36 grit paper and mechanical sander clean the outrigger strengthening section. |
| 26. | Position and secure the strengthening section to the underneath of the outriggers ensuring it fits centrally across the joint and the two sections of the outrigger align correctly with each other. |
| 27. | Ensure that the outer edge of the outrigger remains at an angle of 12° or more. |
| 28. | **Note:** For safety reasons ensure all flammable materials e.g. resin, acetone etc. are removed from the work area. Ensure that the area is free from dust and well ventilated. Ensure that the dust extraction equipment is cleaned regularly. |
| 29. | Puddle and stitch weld the strengthening section to the outrigger. |
| 30. | Using a 36 grit paper and mechanical sander clean all welds and surrounding areas. |
| 31. | Ensure that the area to be zinc primed is free from dust. |
| 32. | Cover all sanded, welded and strengthening plate areas on both sides of the outrigger by painting with a two part zinc rich primer, as per manufacturer's instructions, to provide anti corrosion protection for the outrigger. |
| 33. | Using 36 grit paper and mechanical sander remove all old Beta Seal from the outrigger and small section of the undertray. |
| 34. | Using 36 grit paper and mechanical sander clean both surfaces of both edges to be laminated, feathering outwards from the joint line. |
| 35. | Ensure that the area to be laminated is free from dust. |
| 36. | Apply Beta Wipe 3900 to clean bonding surfaces of small section of undertray and outrigger as shown in drawing no. BJ43-4. |

| Op. No. | Notes |
|---|---|
| 37 | Apply beta Prime 5402 to bonding surfaces of small section undertray and outrigger as shown in drawing no. BJ43-4. |
| 38. | Apply Beta Seal H.V.3. to bonding surface of small section of undertray as shown in drawing no. BJ43-4. |
| 39. | Fit small section of undertray to outrigger and undertray and maintain a gap of 1/8" to 1/4" (3mm to 6mm) between small section and undertray. |
| 40. | Ensure a bond gap of 2mm between small section of undertray and outrigger. |
| 41. | Position, drill and pop rivet the plates to the small section of the undertray and undertray. |
| 42. | Ensure area to be laminated is free from dust. |
| 43. | Wipe sanded area with acetone. |
| 44. | Brush resin onto underneath of the joint. |
| 45. | Apply two layers of resin impregnated 1½oz. chopped strand mat to the underneath of the joint. Roll and tamp down. |
| 46. | Allow resin to cure at a temperature of not less than 15°C. |
| 47. | When the joint has cured, drill out the pop rivets and remove the plates. |
| 48. | Ensure area to be laminated is free from dust. |
| 49. | Wipe sanded area with acetone. |
| 50. | Apply resin to continuous length roving and insert into joint. |
| 51. | Brush resin onto top of joint. |
| 52. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll & tamp down. |
| 53. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre square to top of joint - roll and tamp down. |
| 54. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll & tamp down. |
| 55. | Allow resin to cure at a temperature of not less than 15°C. |
| 56. | Drill and fit 1/4" pop rivets and washers to outside edge of undertray and outrigger. |

| Op. No. | Notes |
|---|---|
| 57 | Drill and fit 1/4" Imex pop rivets and washers to inside edge of undertray and outrigger. |
| 58. | Apply wax film to all surfaces of outriggers both inside and outside as per wax film manufacturer's instruction. |
| 59. | **Note:** Operations 22 to 58 must be carried out on both outriggers. |

Drawing No. BJ43-4 Outrigger Bonding



## BJ.44 - REMOVE OUTRIGGER AND CENTRE SECTION OF UNDERTRAY

**Components**

Centre Section of Undertray Comprising of:-
- Outrigger
- Front and rear jacking points
- Centre section of undertray
- Part of front bulkhead

**Note:** All the above supplied as one section

**Special Tools**
- Saw
- Grinder
- Wire Set
- Lotus Panel Tool T000T1077
- Router
- Marker

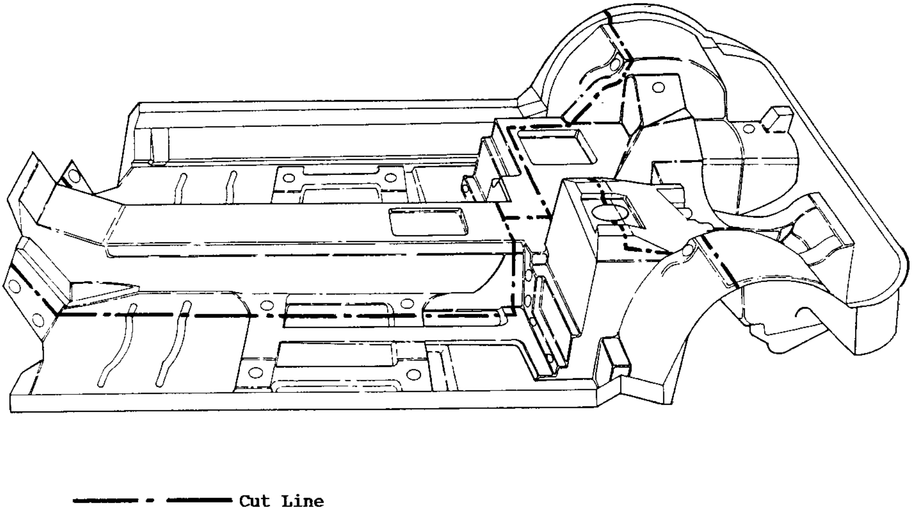
**Important:** Ensure that the petrol tank has been removed before cutting this section of the undertray.

| Op. No. | Notes |
|---|---|
| 1. | Remove seats, floor and 'B' post diaphragm coverings. |
| 2. | Remove dash board. |
| 3. | Remove the four bolts from the 'A' posts which secure the windscreen. |
| 4. | Cut the adhesive between the windscreen and windscreen landing using the wire set. |
| 5. | Remove the windscreen and frame and place aside. |
| 6. | Remove the rear panels, 'B' post cover, 'A' post cover and sill using the Lotus panel tool. |
| 7. | Disconnect the 'B' post cross brace and tie from the relevant 'B' post. |
| 8. | Ensure scuttle beam is disconnected from relevant 'A' post. |
| 9. | Mark the undertray as shown in drawings no. BJ44-1 & 2. |
| 10. | Remove the 4 bolts securing the toe and heel boards to the chassis. |
| 11. | Cut the undertray along the marked line using a router and saw as necessary. |
| 12. | Cut the adhesive from the heel board using the Lotus panel tool. |
| 13. | Cut the adhesive from the 'A' post/bulkhead. |

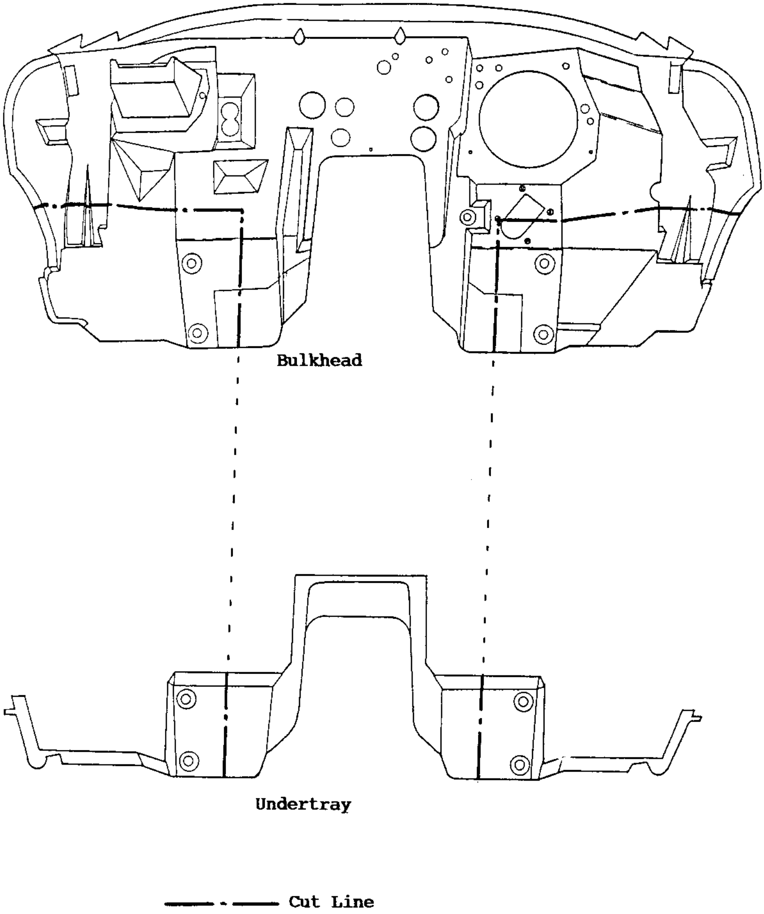
| Op. No. | Notes |
|---|---|
| 14. | Cut the Sealant from top of 'A' post/underneath of screen landing. |
| 15. | Remove and discard damaged section of undertray and outrigger. |

**Drawing No. BJ44-1 Undertray - Centre Section - Cut Lines**

**Undertray Centre Section**



## Drawing No. BJ44-2 Front Bulkhead - Centre Section - Cut Lines


Bulkhead
Undertray
Cut Line

## REFIT UNDERTRAY CENTRE SECTION

**Components**

Centre Section of Undertray

**Materials**

1½oz. C.S.M. Chopped strand mat
Continuous length roving
Resin
Woven glass cloth 300 grams per metre squared
Acetone

**Special Tools**

Jig TOOOF0710
Marker
Saw
36 Grit Paper and Mechanical Sander
Plates

| Op. No. | Notes |
|---|---|
| 1. | Cut new centre section of undertray to suit undertray. |
| 2. | Position jig to car. |
| 3. | Position new centre section to jig and undertray. |
| 4. | Ensure new centre section fits undertray and jig accurately i.e. a gap of 1/8" to 1/4" (3mm to 6mm) should be maintained between both parts of the undertray while ensuring that the jig fits comfortably in the "pick up" and datum points. |
| 5. | Remove the new centre section from the jig and using a 36 grit paper and mechanical sander, clean a "6" strip on both surfaces of both panel edges to be laminated, feathering outwards from the joint line. |
| 6. | Using a 36 grit paper and mechanical sander remove all old Beta Seal from front bulkhead, underneath corner of windscreen landing and under tray. |
| 7. | Refit the new section and ensure it fits the undertray and jig accurately i.e. a gap of 1/8" to 1/4" should be maintained between the new section and the undertray while the jig fits comfortably in the "pick up" and datum points. |
| 8. | Position, drill and pop rivet the plates to the new section and the undertray as necessary. |
| 9. | Ensure the area to be laminated is free from dust. |
| 10. | Wipe sanded area with acetone. |
| 11. | Brush resin onto the underneath of the joint. |
| 12. | Apply two layers of resin impregnated chopped strand mat to the underneath of the joint - roll and tamp down. |

| Op. No. | Notes |
|---|---|
| 13. | Allow resin to cure at a temperature of not less than 15°. |
| 14. | When joint underneath has fully cured, drill out pop rivets and remove plates from the top. |
| 15. | Ensure area to be laminated is free from dust. |
| 16. | Wipe sanded area with acetone. |
| 17. | Apply resin to continuous length roving and insert into joint. |
| 18. | Brush resin onto top of joint. |
| 19. | Apply one layer of resin impregnated 1½oz. chopped strand mat to the top of the joint - roll and tamp down. |
| 20. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre square to the top of the joint - roll and tamp down. |
| 21. | Apply one layer of resin impregnated 1½oz. chopped strand mat to the top of the joint - roll and tamp down. |
| 22. | Allow resin to cure at a temperature of not less than 15°C. |
| 23. | Refit outrigger and pop rivet (See BJ.47) |
| 24. | Wax spray as per manufacturer's instructions. |

## BJ.45 - REMOVE MID-SECTION OF UNDERTRAY

**Component**

Mid section of undertray - comprising of:-
- a) Mid Section of Undertray.
- b) Rear Section of Outrigger Including 'B' Post.
- c) Rear Jacking Point.

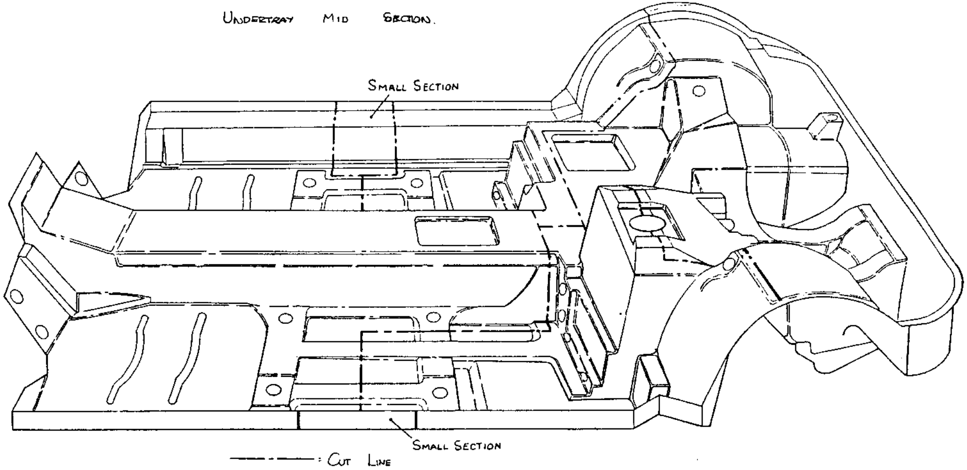
**Special Tools**

Saw
Lotus Panel Tool T000T1077
Router
Marker
Welding Set

**Note:** Ensure that the petrol tank has been removed before commencing with this repair.

| Op. No. | Notes |
|---|---|
| 1. | Remove seats and floor covering |
| 2. | Remove 'B' post diaphragm. |
| 3. | Disconnect 'B' post cross brace and tie brace. |
| 4. | Remove the bolts which secure the heel board to the chassis. |
| 5. | Mark the undertray and outrigger as shown in drawing no. BJ45-1 & 4. |
| 6. | Cut adhesive from inner section of heel board using Lotus panel tool. |
| 7. | Cut the undertray and outrigger along the marked line using a router and saw as necessary. |
| 8. | Remove and discard damaged mid section of undertray and outrigger. |

Drawing No. BJ45-1 Undertray - Mid Section Cut Lines


Undertray Mid Section.
Small Section
Small Section
: Cut Line

## REFIT MID SECTION OF UNDERTRAY

**Components**

Mid section of undertray comprising of:-

a) Mid Section of Undertray
b) Rear Section of Outrigger Including 'B' Post
c) Rear Jacking Point
**Note:** All the above supplied as one section.

Outrigger strengthening section
1/4" Pop Rivets
1/4" Imex Pop Rivets
Washers

**Materials**

1½oz. C.S.M. (Chopped strand mat)
Resin
Continuous length roving
Woven glass cloth 300 grams per metre squared
Acetone
Two Part Primer (Beta Primer VP01706 A & B)
Wax Spray

**Adhesives**

Beta Wipe 3900
Beta Prime 5402
Beta Seal H.V.3.

**Special Tools**

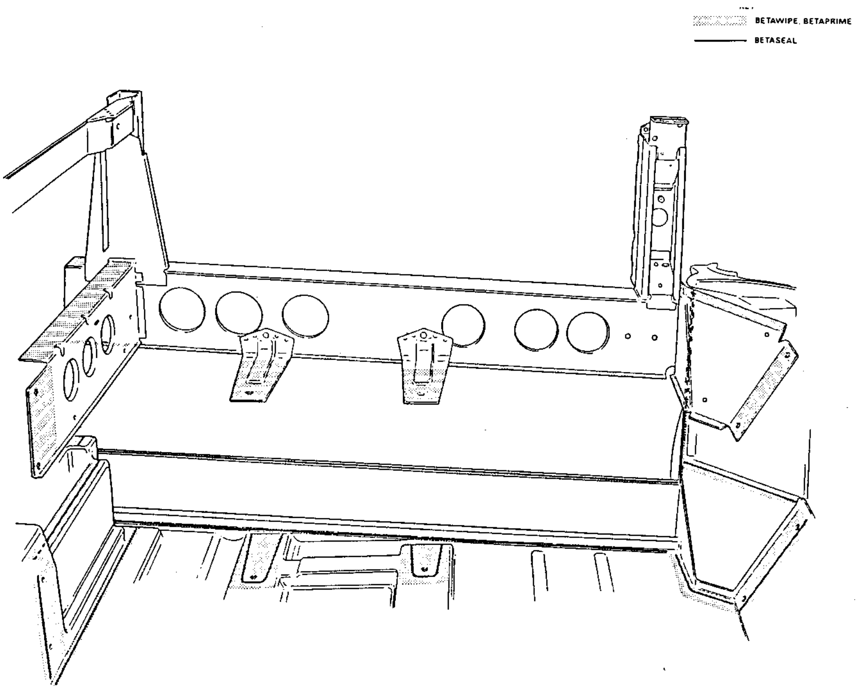
Jig T000F0710
Marker
36 Grit Paper and Mechanical Sander
Plates
Wax Spray Equipment
Beta Seal Dispenser and Nozzle
Welder

| Op. No. | Notes |
|---|---|
| 1. | Cut new mid section of undertray and outrigger to suit area to be repaired. |
| 2. | Position jig to car. |
| 3. | Position new mid section. |
| 4. | Ensure new mid section fits undertray, outrigger and jig accurately, i.e. a gap of 1/8" to 1/4" (3mm to 6mm) should be maintained between the mid section and the undertray while ensuring that the jig fits comfortably in the pick up and datum points. |

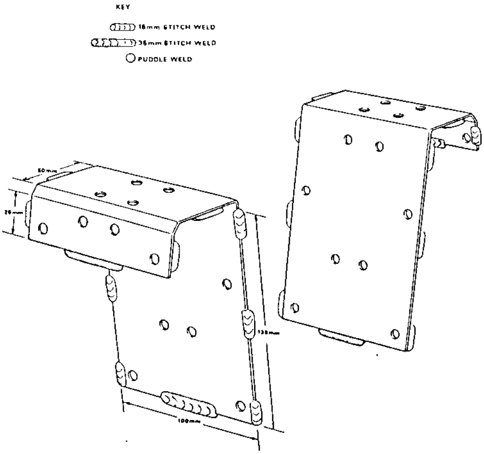
| Op. No | Notes |
|---|---|
| 5. | Remove the new mid-section from the jig and using a 36 grit paper and mechanical sander clean a 6" strip on both surfaces of both panel edges to be laminated feathering outwards from the joint line. |
| 6. | Using a 36 grit paper and mechanical sander remove all old Beta Seal from the undertray. |
| 7. | Ensure that area to be bonded is free from dust. |
| 8. | Wipe bonding surfaces of the undertray and outrigger with Beta Wipe 3900 as shown in drawing no. BJ45-2. |
| 9. | Apply Beta Prime 5400 to bonding surfaces of the undertray and outrigger as shown in drawing no. BJ45-2. |
| 10. | Apply Beta Seal H.V.3. to bonding surface of undertray as shown in drawing no. BJ45-2. |
| 11. | Replace the new mid-section and ensure it fits the undertray, outrigger and jig accurately i.e. a gap of 1/8" to 1/4"(3mm to 6mm) should be maintained between both parts of the undertray, outrigger and mid-section while ensuring that the jig fits comfortably in the "pick up" and datum points. |
| 12. | Position, drill and pop rivet the plates to the new mid-section and undertray as necessary. |
| 13. | Ensure that the area to be laminated is free from dust. |
| 14. | Wipe sanded area with acetone. |
| 15. | Brush resin onto underneath of joint. |
| 16. | Apply two layers of resin wetted 1½oz. chopped strand mat to underside of joint - roll and tamp down. |
| 17. | Allow resin to cure at a temperature of not less than 15°C. |
| 18. | When joint on underneath has fully cured, drill out pop rivets and remove plates from top. |
| 19. | Ensure area to be laminated is free from dust. |
| 20. | Wipe sanded area with acetone. |

| Op. No. | Notes |
|---|---|
| 21. | Apply resin to the continuous length roving and insert into joint. |
| 22. | Brush resin onto top of joint. |
| 23. | Apply one layer of resin impregnated 1½oz. chopped strand mat to the top of the joint - roll and tamp down. |
| 24. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre square to the top of the joint - roll and tamp down. |
| 25. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of the joint - roll and tamp down. |
| 26. | Allow resin to cure at a temperature of not less than 15°C. |
| 27. | Cut a small section of the fibreglass undertray away from the outrigger to be welded as shown in drawing no. BJ45-1. |
| 28. | Ensure a gap of 1/8" to 1/4" (3mm to 6mm) is maintained between both sections of the outrigger, while the "pick up" and datum points fit comfortably on the jig. Secure the two sections of the outrigger together. |
| 29. | Using a 36 grit paper and mechanical sander clean an area up to 2½" (65mm) either side of the joint on the outrigger and the strengthening section. |
| 30. | Position and secure the strengthening section to the underneath of the outrigger ensuring it fits centrally across the joint and the two sections of the outrigger align correctly with each other. |
| 31. | Ensure that the outer edge of the outrigger remains at an angle of 12° or more. |
| 32. | **Note:-** For safety reasons ensure all flammable materials e.g. resins, acetone etc. are removed from the work area. Ensure that the area is free from dust, and well ventilated. Ensure that the dust extraction equipment is cleaned regularly. |
| 33. | Puddle and stitch weld the strengthening section to the outrigger. |
| 34. | Using a 36 grit paper and mechanical sander clean all welds and surrounding area. |
| 35. | Ensure that the area to be zinc primed is dust free. |
| 36. | Cover all sanded, welded and strengthening plate areas on both sides of the outrigger by painting with a two part zinc rich primer as per the manufacturer's instructions to provide anti corrosion protection for the outrigger. |

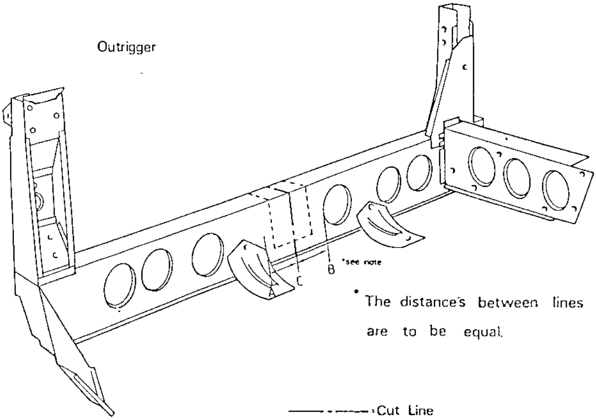
Drawing No. BJ45-2 Outrigger Bonding


BETAWIPE, BETAPRIME
BETASEAL

## Drawing No. BJ45-3 Outrigger Strengthening Section


KEY
18mm STITCH WELD
36mm STITCH WELD
PUDDLE WELD
50mm
26mm
138mm
100mm

## Drawing No. BJ45-4 Outrigger - Cut Line and Strengthening Section


Outrigger
A
C
B
*see note

* The distance's between lines AC and CB are to be equal.

———-———:Cut Line
- - - - - - - - - - - -Backing Plate

| Op. No. | Notes |
|---|---|
| 37. | Using 36 grit paper and mechanical sander remove all old Beta Seal from the outrigger and small section of the undertray. |
| 38. | Using 36 grit paper and mechanical sander clean both surfaces of both edges to be laminated, feathering outward from the joint line. |
| 39. | Ensure that the area to be bonded is free from dust. |
| 40. | Apply Beta Wipe 3900 to clean bonding surfaces of small section of undertray as shown in drawing no. BJ45-2. |
| 41. | Apply Beta Prime 5402 to bonding surfaces of small section of undertray and outrigger as shown in drawing no. BJ45-2. |
| 42. | Apply Beta Seal H.V.3 to bonding surface of small section of undertray as shown in drawing no. BJ45-2. |
| 43. | Fit small section of undertray to outrigger and undertray and maintain a gap of 1/8" to 1/4" (3mm to 6mm) between small section and undertray. |
| 44. | Ensure a bond gap of 2mm between small section of undertray and outrigger. |
| 45. | Position drill and pop rivet the plates to the small section of the undertray and undertray. |
| 46. | Ensure area to be laminated is free from dust. |
| 47. | Wipe sanded area with acetone. |
| 48. | Brush resin onto underneath of the joint. |
| 49. | Apply two layers of resin impregnated 1½oz. chopped strand mat to the underneath of the joint - roll and tamp down. |
| 50. | Allow resin to cure at a temperature of not less than 15°C. |
| 51. | When the joint has cured, drill out the pop rivets and remove the plates. |
| 52. | Ensure area to be laminated is free from dust. |
| 53. | Wipe sanded area with acetone. |
| 54. | Apply resin to continuous length roving and insert into joint. |
| 55. | Brush resin onto top of joint. |

| Op. No. | Notes |
|---|---|
| 56. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll & tamp down. |
| 57. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre square to top of the joint - roll and tamp down. |
| 58. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll & tamp down. |
| 59. | Allow resin to cure at at temperature of not less than 15°C. |
| 60. | Drill and fit 1/4" pop rivets and washers to outside edge of undertray outrigger. |
| 61. | Drill and fit 1/4" Imex pop rivets and washers to inside edge of undertray and outrigger. |
| 62. | Apply wax film to all surfaces of outrigger both inside and outside as per wax film manufacturers instruction. |

## BJ.46 - REPAIR REAR OF UNDERTRAY

**Components**

| | |
|---|---|
| Rear Quarter Undertray L.H./ or R.H. | ] As necessary |
| Rear Half Undertray | ] |

**Materials**

1½oz. Chopped strand mat
Continuous length roving
Resin
Acetone
Woven glass cloth 300 grams per metre squared

**Special Tools**

Jig T000F0710
Marker
3" Diamond Wheel
Plates
Pop Rivets
Brush
Roller
36 Grit Sand Paper and Mechanical Sander

| Op. No. | Notes |
|---|---|
| 1. | Mark out cut line as necessary round the damaged area of undertray to be removed. |
| 2. | Mark out cut line on new rear section of undertray as necessary using cut line on damaged undertray as a guide. |
| 3. | Cut damaged undertray along cut line and remove. |
| 4. | Cut rear section of undertray along cut line. |
| 5. | Using 36 grit paper and mechanical sander clean area 6" around cut line of on both edges of undertray and new undertray section feathering outward from the joint line. |
| 6. | Using jig position new undertray section to undertray leaving a gap of 1/8" to 1/4" (3mm to 6mm). |
| 7. | Position, drill and pop rivet holding plates across top of joint as necessary. |
| 8. | Ensure area to be repaired is free from dust. |
| 9. | Wipe sanded area with acetone. |
| 10. | Brush resin to underside of joint. |
| 11. | Apply 2 layers of resin impregnated 1½oz. chopped strand mat to underside of joint. |

| Op. No. | Notes |
|---|---|
| 56. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll & tamp down. |
| 57. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre square to top of the joint - roll and tamp down. |
| 58. | Apply one layer of resin impregnated 1½oz. chopped strand mat to top of joint - roll & tamp down. |
| 59. | Allow resin to cure at at temperature of not less than 15°C. |
| 60. | Drill and fit 1/4" pop rivets and washers to outside edge of undertray outrigger. |
| 61. | Drill and fit 1/4" Imex pop rivets and washers to inside edge of undertray and outrigger. |
| 62. | Apply wax film to all surfaces of outrigger both inside and outside as per wax film manufacturers instruction. |

## BJ.46 - REPAIR REAR OF UNDERTRAY

**Components**

Rear Quarter Undertray L.H./ or R.H. ] As necessary
Rear Half Undertray ]

**Materials**

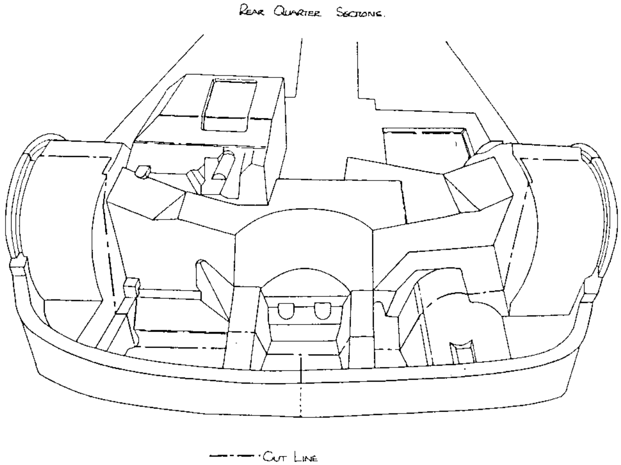
1½oz. Chopped strand mat
Continuous length roving
Resin
Acetone
Woven glass cloth 300 grams per metre squared

**Special Tools**

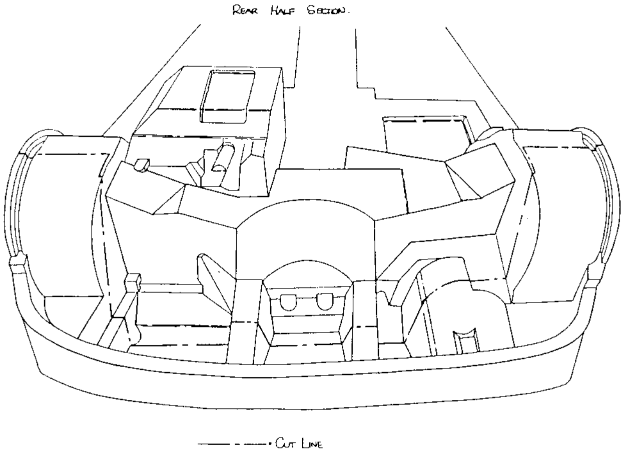
Jig T000F0710
Marker
3" Diamond Wheel
Plates
Pop Rivets
Brush
Roller
36 Grit Sand Paper and Mechanical Sander

| Op. No. | Notes |
|---|---|
| 1. | Mark out cut line as necessary round the damaged area of undertray to be removed. |
| 2. | Mark out cut line on new rear section of undertray as necessary using cut line on damaged undertray as a guide. |
| 3. | Cut damaged undertray along cut line and remove. |
| 4. | Cut rear section of undertray along cut line. |
| 5. | Using 36 grit paper and mechanical sander clean area 6" around cut line of on both edges of undertray and new undertray section feathering outward from the joint line. |
| 6. | Using jig position new undertray section to undertray leaving a gap of 1/8" to 1/4" (3mm to 6mm). |
| 7. | Position, drill and pop rivet holding plates across top of joint as necessary. |
| 8. | Ensure area to be repaired is free from dust. |
| 9. | Wipe sanded area with acetone. |
| 10. | Brush resin to underside of joint. |
| 11. | Apply 2 layers of resin impregnated 1½oz. chopped strand mat to underside of joint. |

## Drawing No. BJ46-1 Rear Quarter Section - Cut Line


Rear Quarter Sections.
Cut Line

## Drawing No. BJ46-2 Rear Half Section - Cut Line


Rear Half Section.
Cut Line

| Op. No. | Notes |
|---|---|
| 12. | Roll and tamp down. |
| 13. | Allow resin to cure in a temperature of not less than 15°C. |
| 14. | When the joint underneath has fully cured, drill out the the pop rivets and remove the plates from the top. |
| 15. | Ensure area to be laminated is free from dust. |
| 16. | Wipe sanded area with acetone. |
| 17. | Apply resin to continuous length roving and insert into joint. |
| 18. | Brush resin onto top of joint. |
| 19. | Apply one layer of resin impregnated 1½oz. chopped strand mat to the top of the joint - roll amd tamp down. |
| 20. | Apply one layer of resin impregnated woven glass cloth 300 grams per metre square to the top of the joint - roll and tamp down. |
| 21. | Apply one layer of resin impregnated 1½oz. chopped strand mat to the top of the joint - roll and tamp down. |
| 22. | Allow resin to cure at a temperature of not less than 15°C. |

## BJ.47 - FIT OUTRIGGER TO UNDERTRAY

**Components**

- Outrigger L.H./R.H.
- 1/4" Pop Rivets
- 1/4" Imex Pop Rivets
- Washer
- Wax spray

**Adhesives**

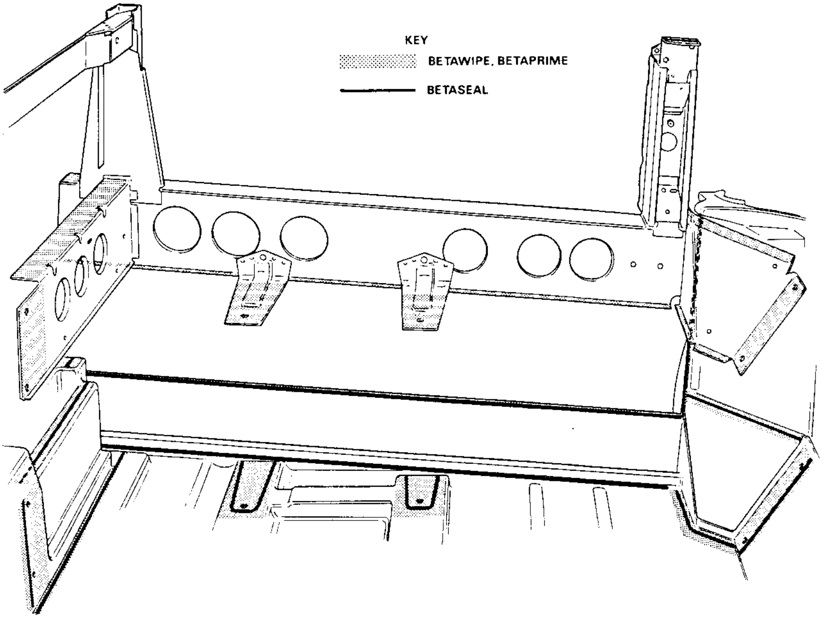
- Beta Wipe 3900
- Beta prime 5402
- Beta Seal H.V.3.

**Special Tools**

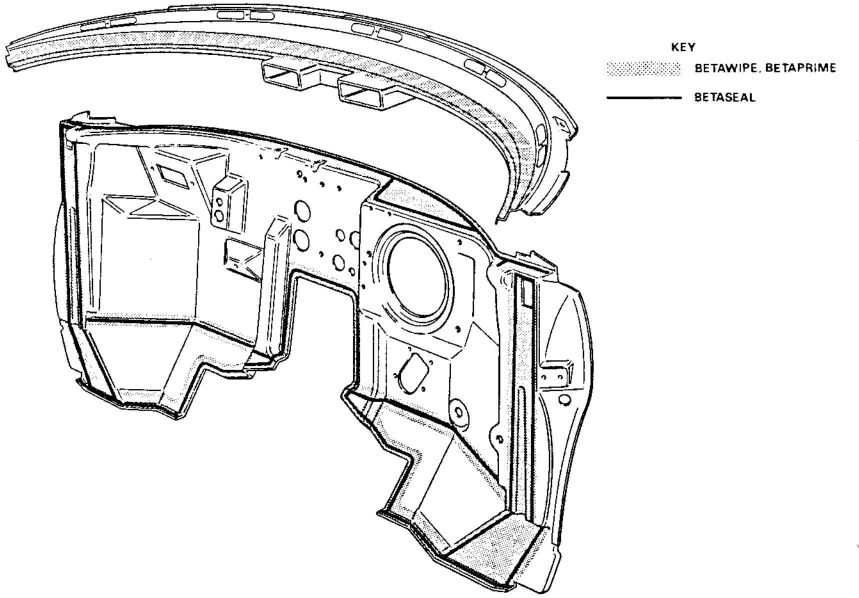
- Jig T000F0710
- Bolts
- Washer
- Nuts
- Fibre Tip Marker
- Beta Seal Dispenser and Nozzle
- Drill
- Pop Riveter
- Wax spray equipment

| Op. No. | Notes |
|---|---|
| 1. | Position outrigger to undertray and temporarily secure by bolting toe and heel boards to undertray. |
| 2 | Fit jig and ensure 'A' post datum and 'B' post striker holes are correctly positioned. |
| 3. | Using fibre tip marker draw line round outrigger so as to mark its position on the undertray. |
| 4. | Remove the jig and outrigger from the undertray. |
| 5. | Apply Beta Wipe 3900 to clean bonding surfaces of undertray, outrigger, 'A' post, bulkhead and underneath of windscreen landing as shown in drawing no. BJ47-1 & 2. |
| 6. | Apply Beta Prime 5402 to bonding surfaces of undertray, outrigger, 'A' post, bulkhead and underneath of windscreen landing as shown in drawing no. BJ47-1 & 2. |
| 7. | Apply Beta Seal H.V.3. to bonding surfaces of undertray as shown in drawing no. BJ47-1 & 2. |
| 8. | Refit outrigger to undertray and secure by bolting the toe and heel boards to the undertray. |
| 9. | Refit jig and check positions of 'A' post datum and striker plate holes are correctly positioned. |

Drawing No. BJ47-1 Outrigger Bonding


KEY
▨ BETAWIPE, BETAPRIME
—— BETASEAL

Drawing No. BJ47-2 Front Bulkhead Bonding


KEY
▨ BETAWIPE, BETAPRIME
—— BETASEAL

| Op. No. | Notes |
|---|---|
| 10. | Position edge of undertray to edge of outrigger and clamp with "G" clamps - ensure a 2mm bond gap. |
| 11. | Remove excess Beta Seal from all joints. |
| 12. | Drill and fit 1/4" pop rivets and washers to outside edge of undertray and outrigger. |
| 13. | Drill and fit 1/4" Imex pop rivets and washers to inside edge of undertray and outrigger. |
| 14. | Fit 'B' post crossbrace to 'B' posts. Fit scuttle beam to 'A' post. |
| 15. | Leave for 16 hours to allow Beata Seal to cure. |
| 16. | Remove "G" clamps. |
| 17. | Remove bolts from toe and heel boards. |
| 18. | Remove jig. |
| 19. | Apply wax film to all surfaces of outrigger both inside and outside as per manufacturer's instructions. |

## BJ.48 - FIT SCUTTLE BEAM

**Components**

Scuttle Beam
Spacers
Bolts
Washers
Nuts

| Op. No. | Notes |
|---|---|
| 1. | Measure distance between the 2 'A' posts to ensure it is 1374mm. |
| 2. | Measure width of scuttle beam. |
| 3. | Using measurements from ops. 1 & 2 above decide which spacers are to be used. |
| 4. | Fit scuttle beam and spacers between 'A' posts. |
| 5. | Secure scuttle beam and spacers to both 'A' posts with 4 x bolts, washers and nuts and 2 x bolts, washers and nuts. |

## BJ.49 - REPAIR OF FIBRE GLASS DAMAGE AROUND BOBBIN

**Components and Materials**

Resin
Acetone
1½oz. chopped strand mat
Unidirectional mat 600/300 gramms per square metre
Woven roving Y 920 - 850 gramms per square metre

**Special Tools**

36 Grit sand paper
Router
Thickness Wax 0.250" Part No. AA 017674
Straight Edge
Fine Line Marker

**Note** - Depending on which bobbin needs to be replaced it may be necessary to remove the body from the chassis.

| Op. No. | Notes |
|---|---|
| 1. | Using straight edge and fine line marker draw two long lines through centre of bobbin hole to form cross. |
| 2. | Using router cut fibre glass to remove bobbin and damaged fibre glass. |
| 3. | Using 30 grit sandpaper clean underneath surface of undertray around hole. |
| 4. | Using 36 grit sandpaper clean upper surface of undertray around hole. |
| 5. | Feather fibre glass edge around hole to produce angled surface. Ensure that area which is to be repaired is free from dust. |
| 6. | Clean underneath and upper surfaces of under tray with acetone. |
| 7. | Fit thicknessing wax to underneath surface of under tray to "blank off" hole. |
| 8. | Brush gel onto top surface of thicknessing wax and allow to dry. |
| 9. | Apply one layer of resin impregnated 1½oz. chopped strand mat - roll and tamp down. |
| 10. | Apply one layer of resin impregnated woven roving Y 920. - roll and tamp down. |
| 11. | Apply one layer of resin impregnated uni-directional mat, chopped strand mat side against woven roving - roll and tamp down. |

| Op. No. | Notes |
|---|---|
| 12. | Apply one layer of resin impregnated 1½oz.chopped strand mat - roll and tamp down. |
| 13. | Leave resin to cure in a temperature of not less than 15°C. |
| 14. | Remove thicknessing wax. |
| 15. | Using straight edge and fine line marker re-join lines of cross to find centre point of bobbin. |
| 16. | Drill hole for bobbin using the centre of cross. |
| 17. | See fit bobbin to under tray. |

## BJ.50 - FIT BOBBINS TO UNDERTRAY

**Components**

M100 under tray
Bobbins

| TYPE | POSITION IN TRAY | PART NO | QTY |
|---|---|---|---|
| Male | Rear wheel arch | A100B0486 | 2 |
| Male | Body | AX75B2266 | 21 |
| Male | Toe board | A100B0308 | 4 |
| Female | Rear wheel arch | A100B0485 | 2 |
| Female | All other positions | AX75B2252 | 25 |

**Adhesive**

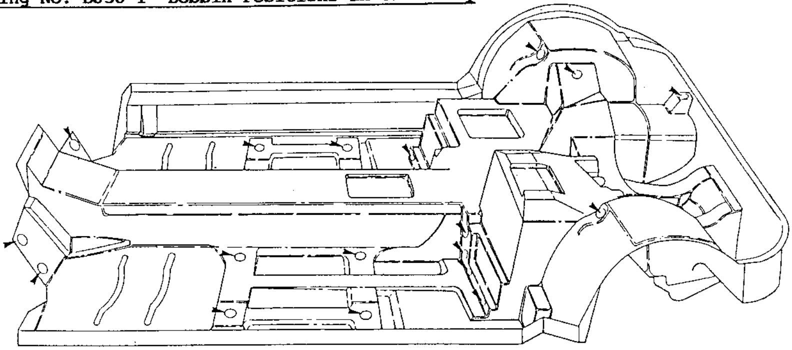
Araldite 2002 (2 part)

**Special Tools**

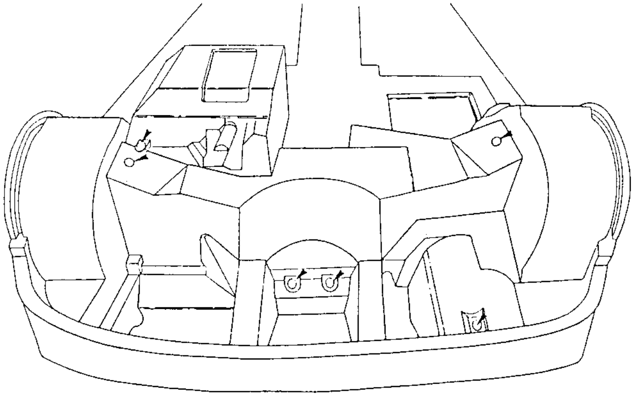
Bobbin crimping tool and air wrench
Araldite nozzle

| Op. No. | Notes |
|---|---|
| 1. | Place 2 part araldite around male and female parts of bobbin, using Araldite nozzle. |
| 2. | Place male part of bobbin through appropriate hole in undertray, ensuring flat side is correctly positioned to act as bearing surface. |
| 3 | Fit female part of bobbin to male part. Crimp end of male part of bobbin using crimping tool and air wrench. |
| 4. | Wipe and remove excess Araldite from joint to produce smooth finish as shown in drawing no. BJ50-3. Allow 15 hours for glue to cure. |

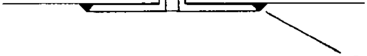
Drawing No. BJ50-1 Bobbin Positions in Undertray



Drawing No. BJ50-2 Bobbin Positions in Undertray



Drawing No. BJ50-3 Araldite - Smooth Finish

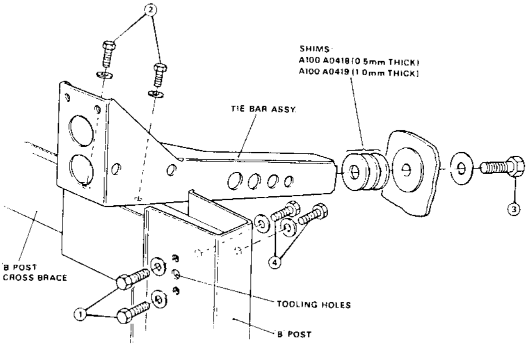


Araldite - Smooth Finish

## BJ.51 - FIT 'B' POST TIE BRACE

INSTRUCTION (Including part numbers & descriptions)

### Drawing No. BJ51-1 'B' Post Cross Brace and Tie Bar Assembly


2
SHIMS
A100 A0418 (0 5mm THICK)
A100 A0419 (1 0mm THICK)
TIE BAR ASSY.
3
4
'B POST
CROSS BRACE
TOOLING HOLES
1
'B' POST

Bolt specifications

Bolt 1 M8x16 (A075W1036Z)
Plus Washer 21/64 x 1¼ x 1/8 (A085W4022Z)

Bolt 2 M8x1.25x16 (A075W1036Z)
Plus Washer 8mm x 16.6X1.4 (A075W4020Z)

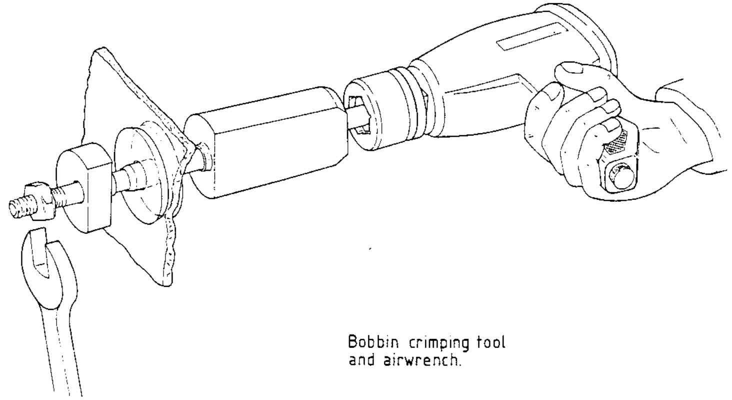
Bolt 3 M10x1.5x35 (A075W2051Z)
Plus Washer (10mm x 30x3) (A075W4027Z)

**Assembly Sequence**

| Op. No. | Notes |
|---|---|
| 1. | Insert crossbrace into B post & align tooling holes. |
| 2. | Insert & tighten bolts (1) torque 22-5Nm max). |
| 3. | Lay tie bar assy. in place & insert bolts (2) (leave 3mm free play approx.). |
| 4. | Insert shims to take up gap between bar & bobbin: insert & tighten bolt (3) with washer) torque to 40Nm. |
| 5. | Tighten bolts (2) & torque to 22.5Nm. Insert & tighten bolts (4) torque to 22.5Nm. |
| 6. | Remove bolts (1). |

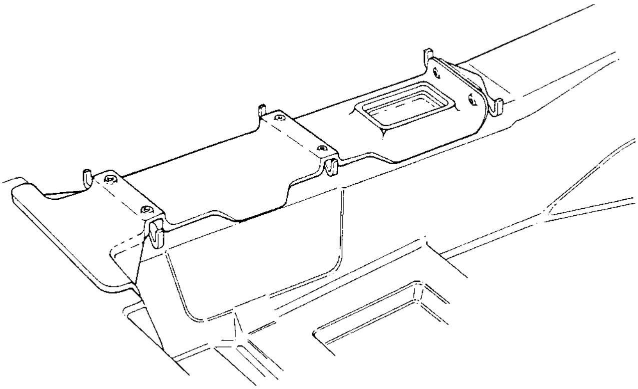
**Note:** Apply Permabond 'A'-121 (A907E6252 to bolts (2), (3) & (4).

**BJ.52-JIGS ETC.**



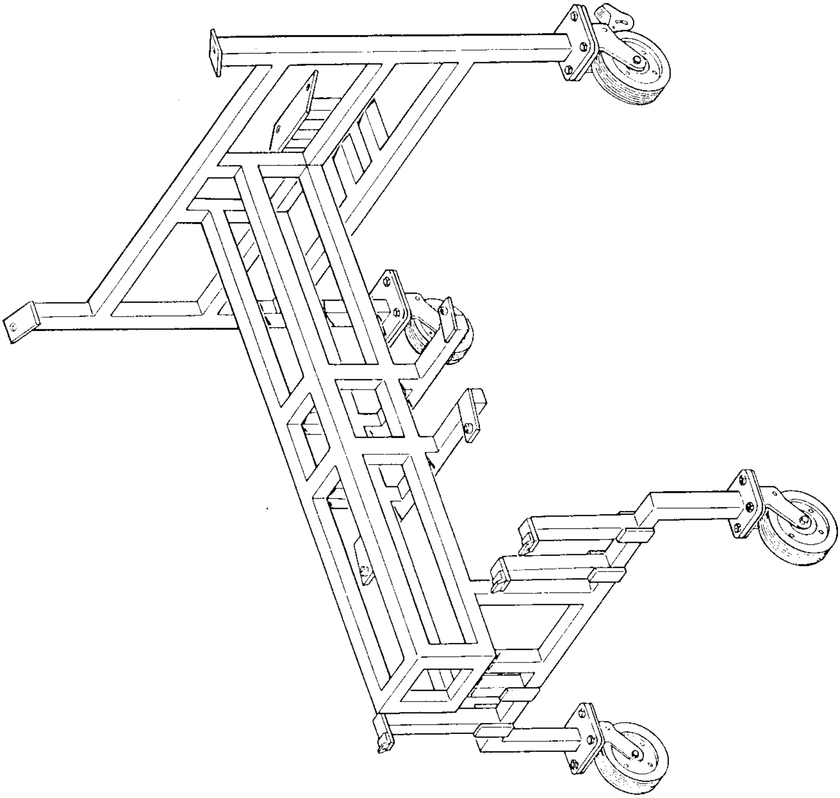
Bobbin crimping tool
and airwrench.

T000T1078.



Centre consul mounting bracket
bonding jig.

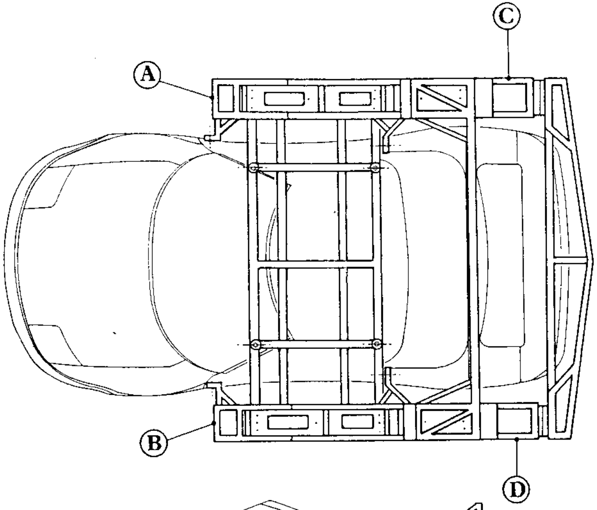
T000F0712.

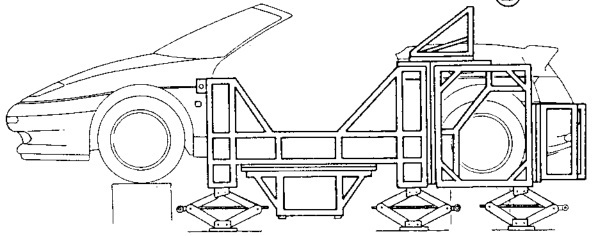


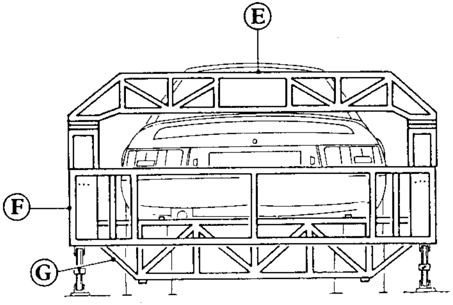
Body repair trolley.

T000F0714

## CRASH REPAIR JIGS.







Ⓐ RHD 'A'&'B' POSTS JIG.

Ⓑ LHD 'A'&'B' POSTS JIG.

Ⓒ RHD QUARTER PANEL JIG.

Ⓓ LHD QUARTER PANEL JIG.

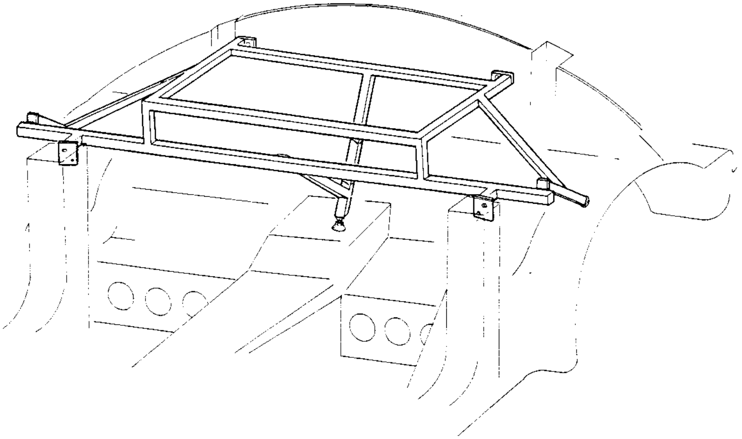
Ⓔ REAR TOP PANEL JIG.

Ⓕ REAR FLANGE JIG.

Ⓖ FLOORTRAY TOOLING HOLE JIG.

T000 F0710

Rear bulkhead jig.



T000F0711.

BJ.53 - LEGISLATION.

**IMPORTANT.** - Welding, laminating, use of resins, solvents etc., are governed by strict laws. In order to ensure compliance with all relevant regulations relating to workshop design and health and safty at work etc., you are strongly advised to consult your local Health and Safety Executive or a local Solicitor before commencing any such work. Lotus Cars Ltd., can accept no liability for any infringement of such regulations by any third party repairer.

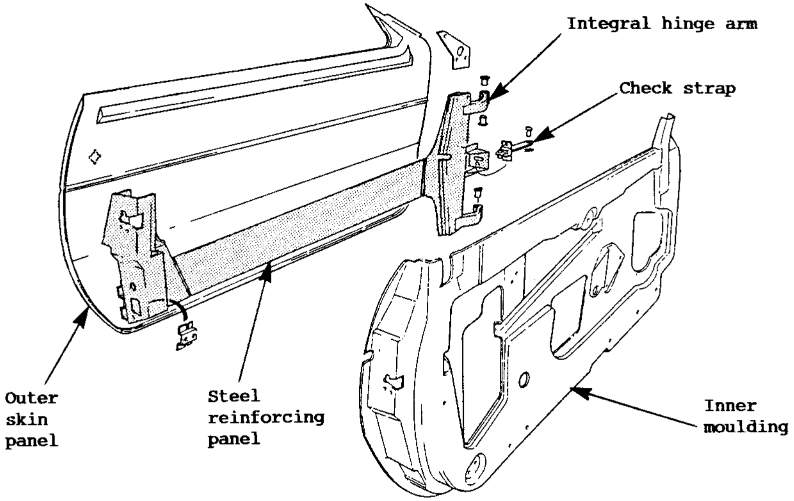
# BODY FITTINGS

## SECTION BK - ELAN

| | Sub-Section | Page |
|---|---|---|
| Door Assemblies | BK.1 | 2 |
| Door Latch Mechanism | BK.2 | 4 |
| Door Window Glass | BK.3 | 8 |
| Door Window Lift Mechanism | BK.4 | 14 |
| Door Mirrors | BK.5 | 14 |
| 'A' Post Panels | BK.6 | 15 |
| Front Topshell | BK.7 | 15 |
| Front Bumper/Spoiler | BK.8 | 19 |
| Rear Bumper | BK.9 | 20 |
| Bonnet Panel | BK.10 | 22 |
| Boot Lid | BK.11 | 22 |
| Roof Stowage Lid | BK.12 | 24 |
| Soft Top Roof | BK.13 | 27 |
| Headlamp Mechanism | BK.14 | 30 |
| Windscreen & Mirror Plinth | BK.15 | 40 |
| Windscreen Pillar Weatherstrips | BK.16 | 45 |
| Windscreen Frame | BK.17 | 47 |
| Body Removal | BK.18 | 51 |
| Addendum 1 - Water Ingress; areas of attention | ADDENDUM 1 | 55 |
| Addendum 2 - Replacement of fold back headlamps by single pivot type | ADDENDUM 2 | 74 |

## BK.1 - DOOR ASSEMBLIES

Each door assembly comprises of an inner composite moulding, to which is bonded by poyurethane adhesive, a heat treated steel reinforcing beam carrying the door latch mechanism at the rear end, and two integral hinge arms at the front end. A composite outer skin panel is then bonded to this assembly with polyurethane adhesive. For some markets, including the USA, a door interlock locator spigot fitted near the bottom of the 'B' post, engages with an interlock eye on the door to help stabilise the door beam in the event of a side impact.



### Hinges

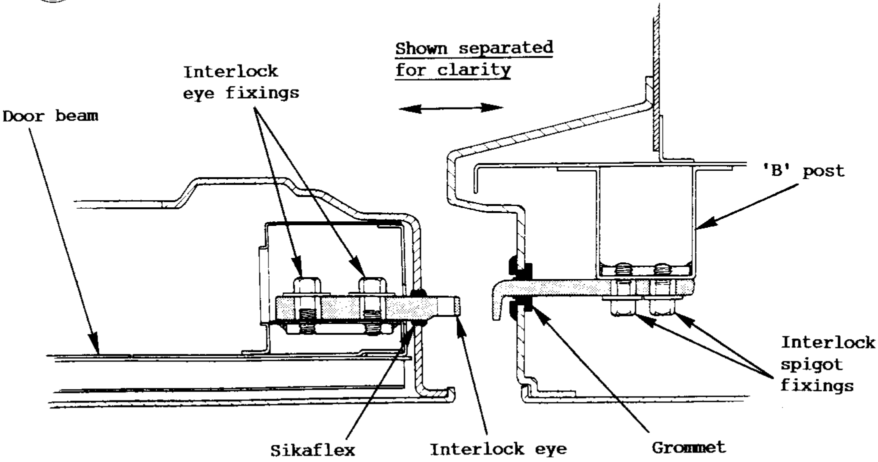
The two door hinge arms, integral with the door beam, are fitted with self lubricating Glacier 'DU' bushes and pivot on steel hinge pins. The pins connect the hinge arms to hinge brackets bolted to carriers which are themselves bolted to the 'A' post. One end of the hinge pins is tapered to aid assembly, and the other end is provided with a collar and head to aid removal. The pins are retained in the hinge brackets, by the interference fit of a straight knurled section on the pins just beneath the head, whilst a circlip at the tapered end of the pin provides a safety back up.

### Hinge Adjustment

When correctly adjusted, the shutline around the door edge should be approximately 5 mm, with the door creaseline aligned with the front and rear wings.

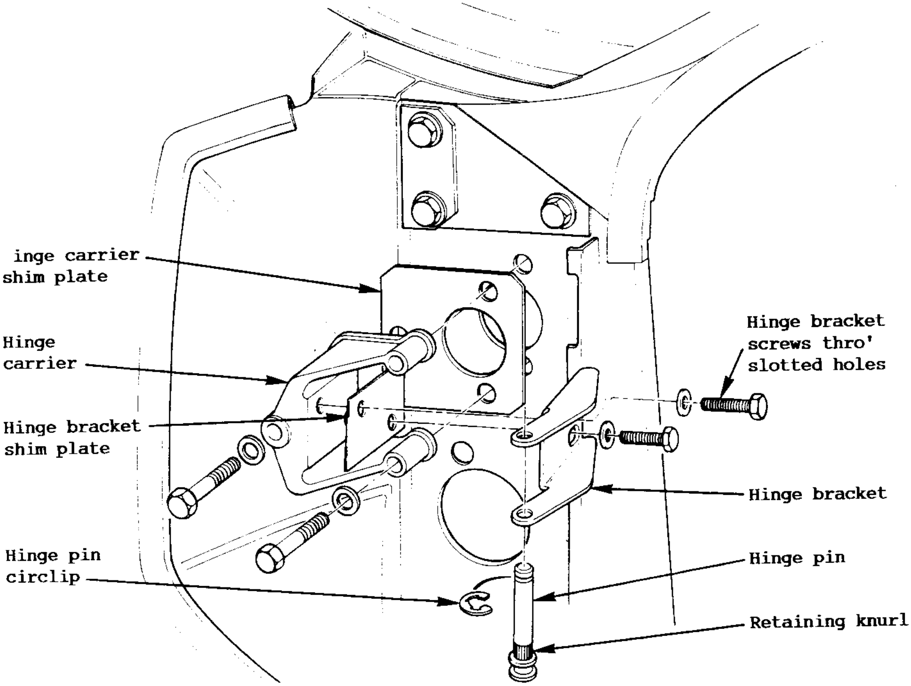
To adjust the door shutlines:

1. On cars fitted with an interlock locator near the bottom of the door shut face, first remove the door trim panel and loosen the fixings securing the interlock eye to the door beam.


Shown separated for clarity
Interlock eye fixings
Door beam
'B' post
Interlock spigot fixings
Sikaflex
Interlock eye
Grommet

2. Remove the 'A' post panel (see section BK.6).

3. Up/down adjustment is available by slackening the three bolts securing each hinge carrier to the 'A' post (caged tapping plate), and moving as required.


inge carrier shim plate
Hinge carrier
Hinge bracket shim plate
Hinge pin circlip
Hinge bracket screws thro' slotted holes
Hinge bracket
Hinge pin
Retaining knurl

4. Fore/aft adjustment is achieved in the same way, but if more is required, shim plates may be fitted (or removed from) between each hinge bracket and carrier.

5. In/out adjustment is made by slackening the two bolts securing each hinge bracket to the carrier (slotted fixing holes). If this is insufficient, shim plates may be fitted (or removed from) between the hinge carrier and 'A' post. When re-fitting a hinge carrier, seal around each fixing hole on the hinge post with Silastic. Completely seal the tooling hole just above the lower hinge carrier front fixing hole. When adjustment is complete, remove each of the hinge carrier bolts in turn, and apply a small amount of Silastic into each bolt hole before re-fitting and tightening the bolts.

6. When shutlines are satisfactory, on cars so equipped, adjust the interlock locator eye on the rear end of the door beam to align with the interlock spigot on the 'B' post. Tighten the fixings, and seal the gap between interlock eye and door shell with Sikaflex leaving a neat finish.

To Remove Door Assembly

To retain adjustment when a door assembly is to be removed, the hinge pins should be withdrawn rather than removing the hinge brackets or carriers.

1. Remove the 'A' post panel (see section BK.6).

2. From inside each end of the fascia, release the two door harness connectors, and feed out through the body hole with the grommet.

3. Press out the spring pin securing the check strap to the 'A' post.

4. Remove the spring clip from the tapered end of each hinge pin, and draw out each pin, the top pin downwards, and the bottom pin upwards. The pins have a straight knurl just beneath the head, which is an interference fit into the hinge bracket hole. Do NOT attempt to loosen a pin by turning, or the interference fit will be lost. A straight pull is required.

Refit the door in the reverse order to removal, noting that the hinge pins require no lubrication, and that the upper pin must be fitted from below, and the lower pin from above, in order to permit their removal with the front topshell in place.

The door weatherstrip is retained by push in plugs at each end, and 25 captive 'fir tree' fasteners. In addition, the front top end of the weatherstrip, is sealed between weatherstrip and door with Sikaflex, and a drop of Permabond C2 adhesive is used to secure the rear end of the seal around the top rear edge of the door. If removing the seal, use a scalpel blade to carefully cut the adhesive and cause the minimum damage to the seal.

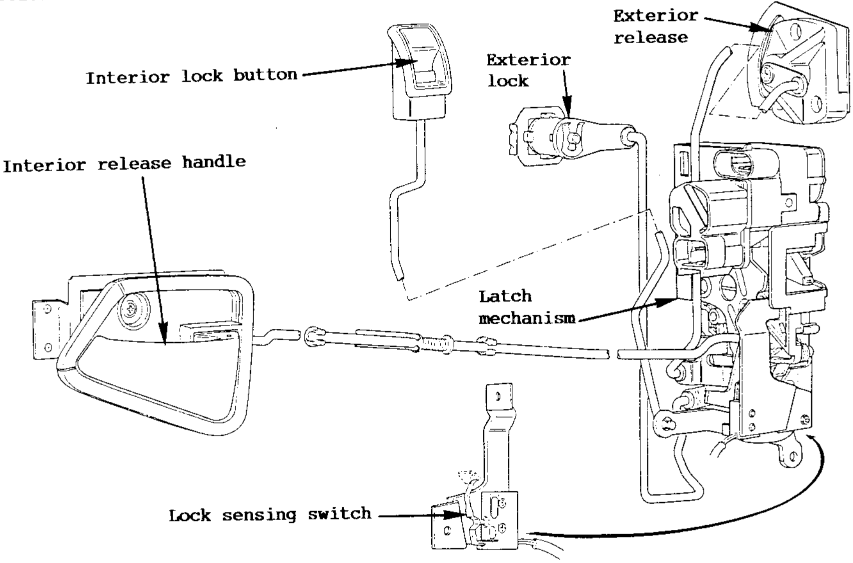
## BK.2 - DOOR LATCH MECHANISM

Each door latch mechanism consists of:

- a latch assembly with integral electrically operated central locking actuator, door ajar switch and interior lamps switch;
- an exterior key locking barrel;
- an exterior release handle on the door rear shut face;
- an interior release handle;
- an interior lock button at the top rear of the door;

a lock sensing switch mounted by a bracket to the bottom of the latch mechanism.

The doors are opened from outside by unlocking with the key, and lifting the release handle. From inside, raise the sill button to unlock and pull the release handle.



The central locking will operate from both the external key lock and internal sill button, but the doors can only be locked when both doors are closed. If a door is locked when either door is open, or closed only on the first latch (ajar), the central locking system will first operate to lock the doors, but after a two second delay, will unlock the doors again. This feature guards against inadvertently locking the keys inside the car. In the event of a flat battery, the CDL will not operate, and each door must be locked or unlocked manually. In an accident severe enough to trigger the safety inertia switch (7g), in addition to the fuel pump feed being switched off, the CDL system will operate to unlock both doors.

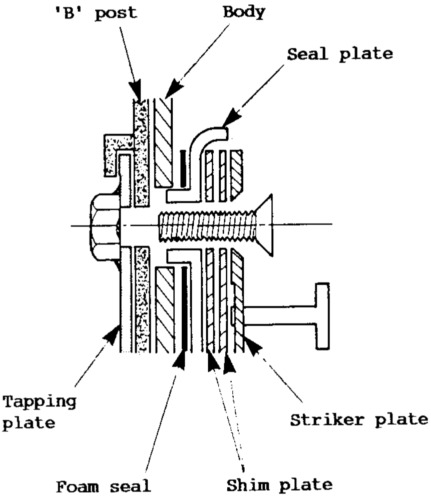
For full electrical details of the CDL operation, see section MJ.

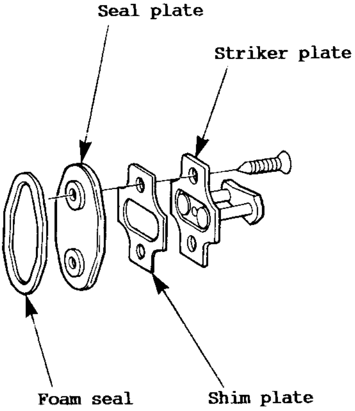
Adjustment

Before carrying out any adjustments to the latch mechanism, first ensure that the door shutlines are correct and if necessary adjust at the hinges (see sub-section BK.1).

The striker plate is mounted on the door jamb by two Torx socket head screws, which thread into a captive tapping plate in the steel 'B' post. Provision is made via oversize fixing holes to allow for the striker plate to be moved up/down to align with the latch mechanism slot, and inboard/outboard to adjust the door shutline and door seal compression. By the addition or deletion of shim plates between the striker and the seal plate, alignment of the striker hoop may be achieved with the latch mechanism.

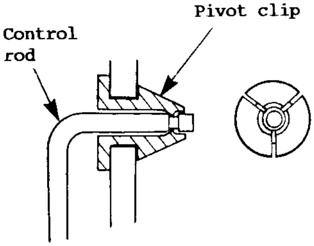
If the striker is removed, ensure that the components are assembled in the correct order - the seal plate fits with its foam seal against the body, followed by the striker shims, then the striker plate.


'B' post
Body
Seal plate
Tapping plate
Foam seal
Shim plate
Striker plate


Seal plate
Striker plate
Foam seal
Shim plate

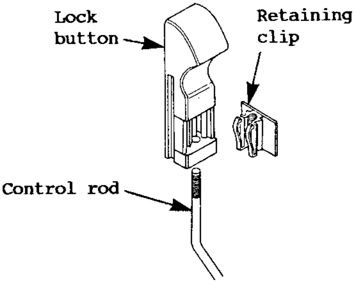
Control Rods

All latch and lock control rods are of fixed length, with no adjustment being necessary. The connection of each of the control rods to the latch mechanism, external release handle and exterior lock, is made via plastic pivot clips which engage with grooves in the ends of the rods. The rods may be prised out of the clips by levering against the bend in the rod. Replace the clips if the retaining tangs are damaged during removal, or if the rod is insecure on re-fitment.


Control rod
Pivot clip

The interior lock button is secured to its control rod by an orange plastic clip which must be prised out prior to removing the door trim panel, and will usually require renewal.

When fitting the button, raise the rod fully, position the button so that the bottom edge of the clip recess is 1 - 2 mm above the trim panel escutcheon, and press home the orange clip.


Lock button
Retaining clip
Control rod

## Replacement of Latch & Lock Components

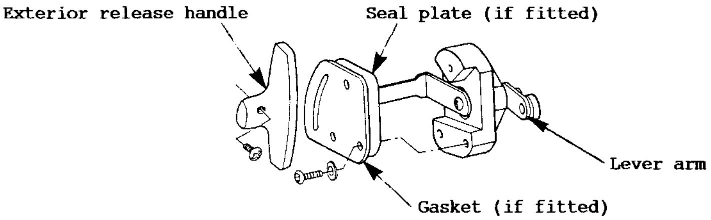
Latch mechanism:

- Remove the door glass and the glass rear guide channel (see section BK.5).
- Disconnect all the control rods from the latch mechanism.
- Unplug the two electrical connectors from the mechanism and the connector to the lock sensing switch.
- Remove the three screws retaining the latch mechanism to the door, and withdraw the mechanism.

Refit the latch mechanism in the reverse order to removal, ensuring that the exterior release handle is fitted first.

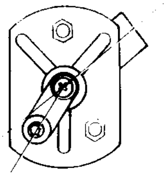
Exterior release handle assembly:

The exterior release knob is retained by a recessed single screw, and the release handle assembly is retained by three M4 button head fixing screws.

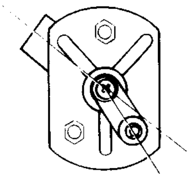

Exterior release handle
Seal plate (if fitted)
Lever arm
Gasket (if fitted)

If the handle assembly is dismantled, check that the lever arm is fitted the correct way round on re-assembly to achieve the orientation shown below. The seal plate and gaket were fitted only on early cars and may be omitted.

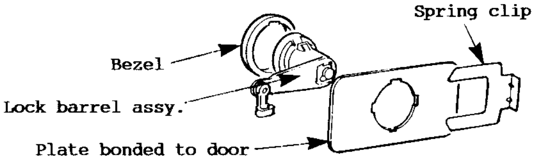
**Left Hand**



**Right Hand**

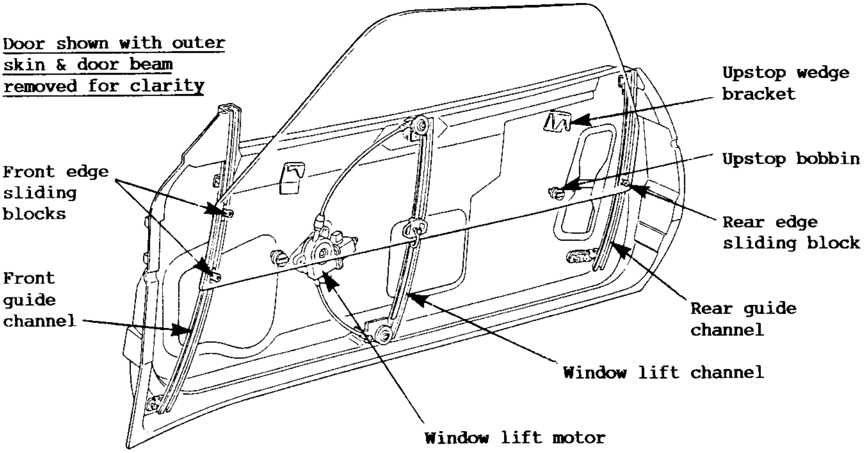


The exterior lock barrel is retained in the door by a spring steel clip which has a tab to aid its removal.


Spring clip
Bezel
Lock barrel assy.
Plate bonded to door

## BK.3 - DOOR WINDOW GLASS

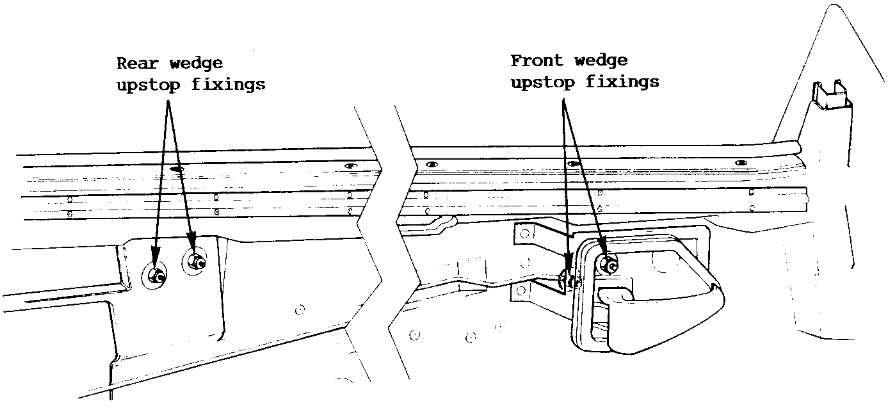
The door window glass is electrically operated, and is fitted with two nylon sliding blocks fixed to its front edge, and two sliding blocks at the rear edge. These sliders operate in steel channels fixed inside the door shell, which guide the glass as it travels up and down. The up position of the glass is controlled by two nylon 'bobbins' fixed to the lower edge of the glass, which abut against 'V' shaped wedge brackets bolted to the inside top of the door shell.


Door shown with outer skin & door beam removed for clarity
Front edge sliding blocks
Front guide channel
Upstop wedge bracket
Upstop bobbin
Rear edge sliding block
Rear guide channel
Window lift channel
Window lift motor

### Adjustment of Door Glass

Before any adjustment to the door glass position is attempted, first ensure that the soft top roof is correctly adjusted (see later). The fit of the raised door glass to the roof seal and screen pillar seal, may be adjusted by two means:

- Up stop adjustment: The raised height of the glass should be adjusted so that the top edge of the glass fits snugly into the moulded weatherstrips on the screen pillar and roof cant rails and 'B' post. To adjust the upstops, lower the glass, remove the door trim panel (see section VD) and door speaker. Slacken the upstop wedge bracket mounting bolts at front and rear. The front bracket fixings


Rear wedge upstop fixings
Front wedge upstop fixings

are accessible behind the door release handle. Move both the brackets in the direction required, tighten, and raise the glass to examine the fit.

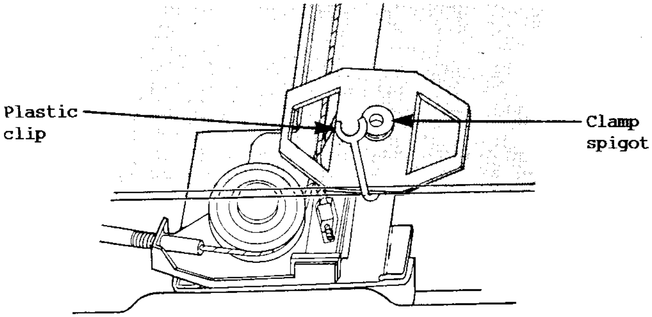
- Inward tilt adjustment: The inward tilt of the glass should be adjusted so that the whole of the periphery of the raised glass, makes light contact with the weatherstrips on the screen pillar and roof cant rails/'B' post. The tilt may be adjusted by slackening the lower, slotted fixings, securing the bottom end of the front and rear guide channels to the door shell, and moving inwards or outwards as required. Also slacken the window lift channel mounting bracket to door shell fixings, and move the lift channel in line with the guide channels. Tighten all fixings after adjustment.

Removal of Door Glass

1. Remove the door trim panel (see section VD), door speaker, and the polythene sheets over the access holes.

2. Remove both upstop bobbins from the lower edge of the glass by releasing the single screw securing each bobbin to its alloy tapping plate.

3. Release the lifting clamp from the glass by pulling off the plastic clip from the outboard side of the clamp spigot, and slackening the lower fixings of the lift channel to allow the clamp spigot to be withdrawn from the glass.

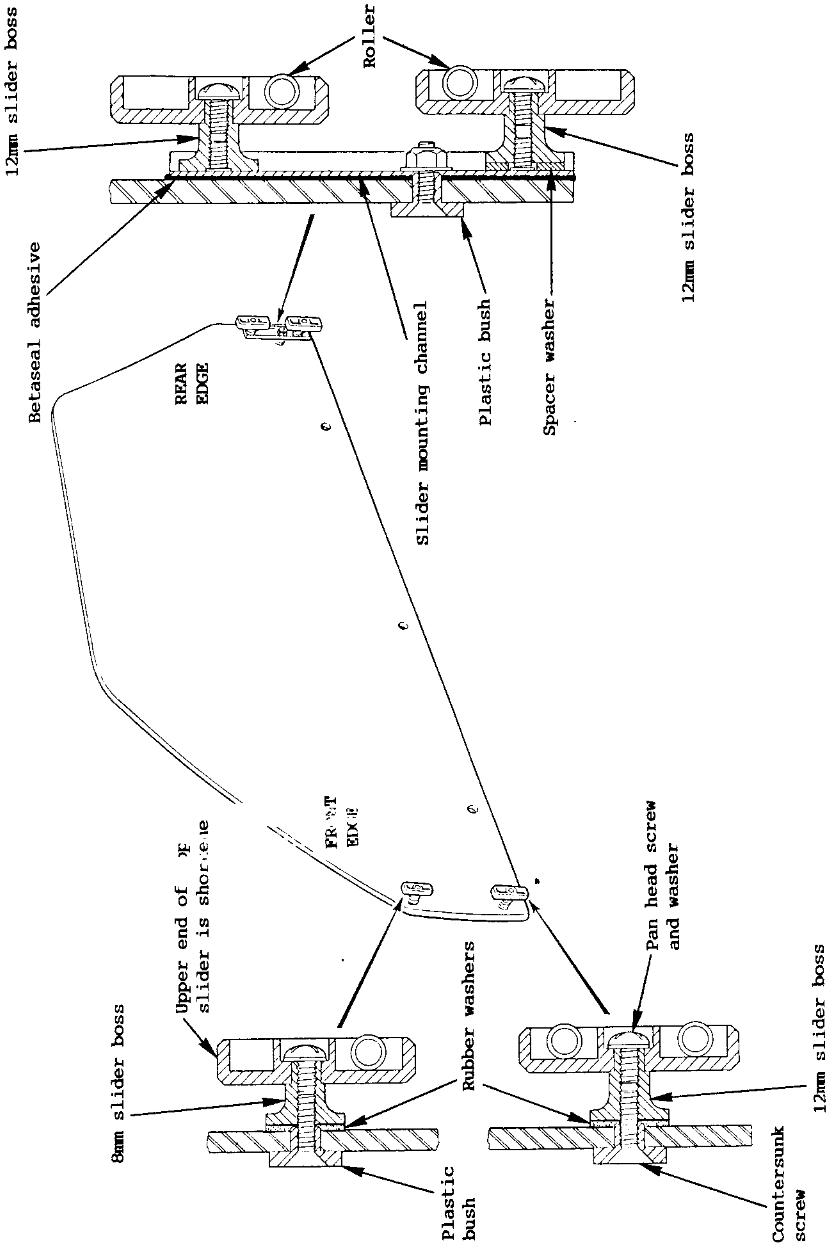


4. Withdraw the glass upwards and out of the door.

Refitment of Door Glass

1. First ensure that the following parts are fitted into the door:
   - external wipe seal;
   - inner and outer glass support pads;
   - motor/cable/lift channel assembly;
   - front and rear guide channels;
   - front and rear upstop wedge brackets.

2. Assembly of slider blocks:
   i) Check that the slider mounting channel is securely bonded to the rear edge (concave side) of the glass. If necessary, rebond using Betaseal cleaner, primer and adhesive as used for the windscreen. The channel should be parallel with the glass rear edge. Locate the channel to the glass with a plastic bush, countersunk screw, flat washer and nyloc nut.
   ii) Apply Permabond A905 to the threads in the plastic bushes and slider bosses. Apply a drop of Permabond F201 (A100B6140F) to the lower stud on the mounting channel, before fitting a flat spacer washer and a 12mm slider

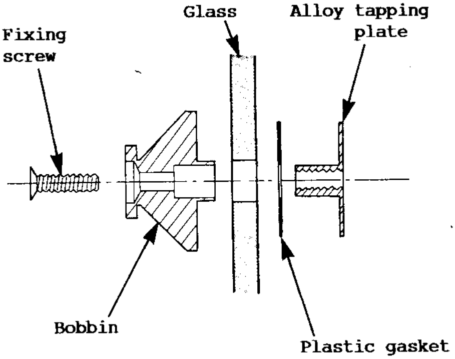

12mm slider boss
Roller
12mm slider boss
Betaseal adhesive
Slider mounting channel
Plastic bush
Spacer washer
REAR EDGE
FRONT EDGE
Upper end of the slider is shortened
8mm slider boss
Rubber washers
Pan head screw and washer
12mm slider boss
Plastic bush
Countersunk screw

mounting boss. Tighten the boss using pliers. In the same way, fit another 12mm boss to the top stud, but do not use a spacer washer.
iii) Fit a slider block to each of the mounting bosses and retain with a flat washer and M4 screw, with a spot of Permabond F201 applied to the thread. Tighten the screw, but ensure that the slider is still able to turn.
iv) Assemble the slider mounting bosses to the front edge of the glass (concave side), using a plastic bush and countersunk screw fitted from the outboard (convex) side, and a rubber washer and mounting boss on the inside. Note that an 8mm boss is fitted at the top position, and a 12mm boss at the lower front position. Apply a drop of Permabond F201 to the screw thread before tightening.
v) Fit a slider block to each of the front mounting bosses and retain with a flat washer and M4 screw with a drop of Permabond applied to the thread. Note that the top slider block is shortened at its upper end. Tighten the slider block screws, but ensure that the sliders are still able to turn.
vi) Fit rollers into each of the slider blocks:

- upper front slider; roller in lower cavity;
- lower front slider; roller in both upper and lower cavities;
- upper rear slider; roller in lower cavity;
- lower rear slider; roller in upper cavity.

vii) Lubricate the slider blocks with petroleum jelly.

3. Fit the glass into the door with the slider blocks engaged in the guide channels. Fit the two upstop bobbins to the lower edge of the glass, with double sided tape or a plastic gasket fitted between the alloy tapping plate and the glass.



4. Fit the spigot of the lifting clamp through the glass, and retain with the plastic clip. Adjust the lower end of the lift channel to be in alignment with the guide channels.

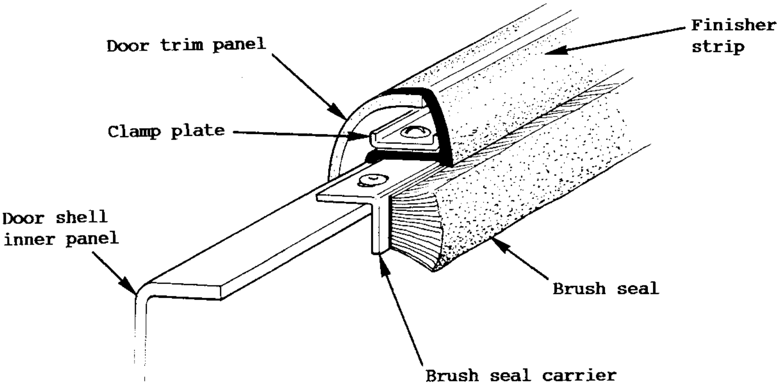
5. Adjust the glass position if necessary, as detailed above.

Door Glass Internal Wipe Seal

A brush type seal is attached to a carrier which is rivetted to the top of the door shell inner panel. A rubber finisher strip is fixed over the seal carrier, and lips over the top of the door trim panel.

To Remove:

- Remove the door trim panel.
- Remove the 8 screws securing the finisher strip clamping plate, and remove plate. Carefully peel finisher strip from its double sided tape.
- Remove the screw securing the downturned rear end of the brush seal carrier.
- Drill out the 5 rivets securing the brush seal carrier to the door, and ease the carrier from the door, using a blade if necessary to release the sealing strip between carrier and door.



To Refit:

1. Clean any sealant from the top edge of the door shell, and underside of the seal carrier. Apply primer (A082U6199V) to the underside of the seal carrier and top of the door shell. Allow to dry.

2. Apply a 95mm length of sealing strip (A089V6166V) to the underside of the seal carrier, aligning with the edge and ends.

3. Fit the carrier onto the door and push fully forwards with the carrier rear tag held hard against the rear face of the door shell. Secure the seal carrier using 5 off 1/8" pop rivets. Secure the rear end tag with a screw, washer and captive nut.

4. Apply primer (A082U6199V) to the top surface of the brush seal carrier, and to the underside of the rubber finisher strip. Allow to dry.

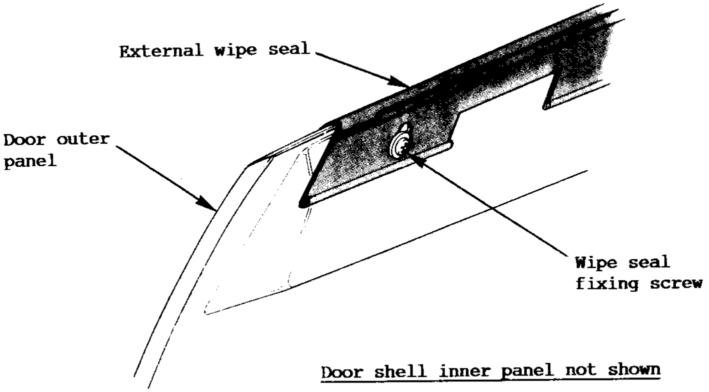
5. Fit a length of double sided tape (B100B6088V) to the top of the brush seal carrier, with the edges and ends aligned. Fit the finisher strip onto the tape with the edges and ends aligned, and press down firmly.

6. Fit the clamp plate into the finisher strip, with the edges turned upwards, and the cut outs inboard. Use a scriber to locate the fixing holes in the brush seal carrier, pierce the finisher strip accordingly, and secure the clamp plate and finisher using 8 screws.

7. Refit the door trim panel.

External Wipe Seal

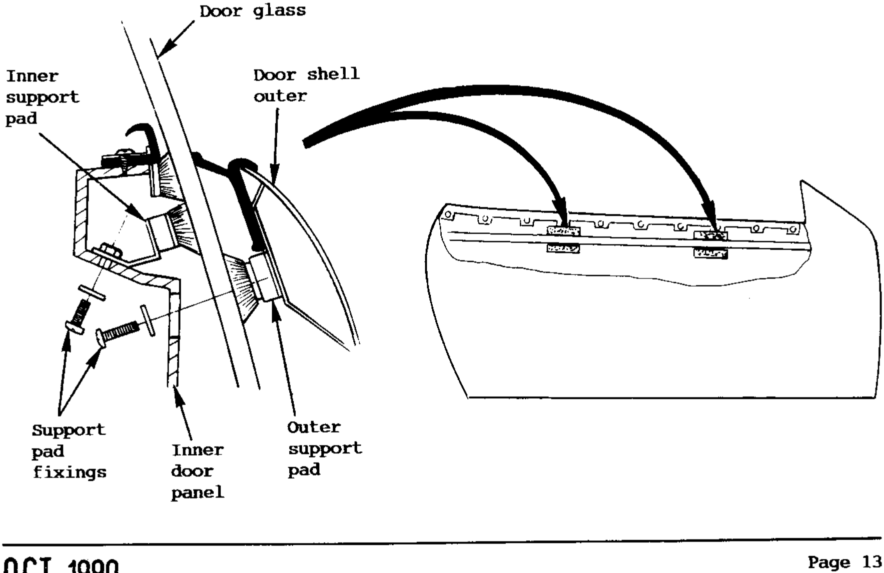
The door glass external wipe seal is secured inside the door outer panel top edge by 10 screws. The screws are accessible only with the door trim panel and door window glass removed, via holes in the inner door panel.


External wipe seal
Door outer panel
Wipe seal fixing screw
Door shell inner panel not shown

Glass Support Pads

Two outer support pads, and two inner pads are fixed inside the top of the door shell to provide additional support to the door glass.

Each of the outer two pads are secured to the outer door shell with two screws and washers accessible only with the door glass removed. The position of the inner pads, which are fixed to the inside of the inner door shell with a single screw and washer, should be adjusted so that the pads just touch the door glass in its lowered position.


Door glass
Inner support pad
Door shell outer
Support pad fixings
Inner door panel
Outer support pad

## BK.4 - DOOR WINDOW LIFT MECHANISM

The door windows are controlled by two switches on the centre tunnel, one each side of the parking brake lever. The windows operate only with the ignition switched on, when a white dot marker on each switch is illuminated to help locate the controls. Pressing the front, domed end of the rocker switch lowers the window, and pressing the rear, dished end raises the glass.

An electric motor and cable mechanism within each door, uses a lift channel to guide a plastic clamp which is spigotted through the glass. The top and bottom of the lift channel are fitted with pulley wheels to guide the lift cable, and spring loaded outer cable abutments maintain tension on the cable to take up any slack. The complete assembly of motor/lift cable/lift channel, is serviced only as one unit.

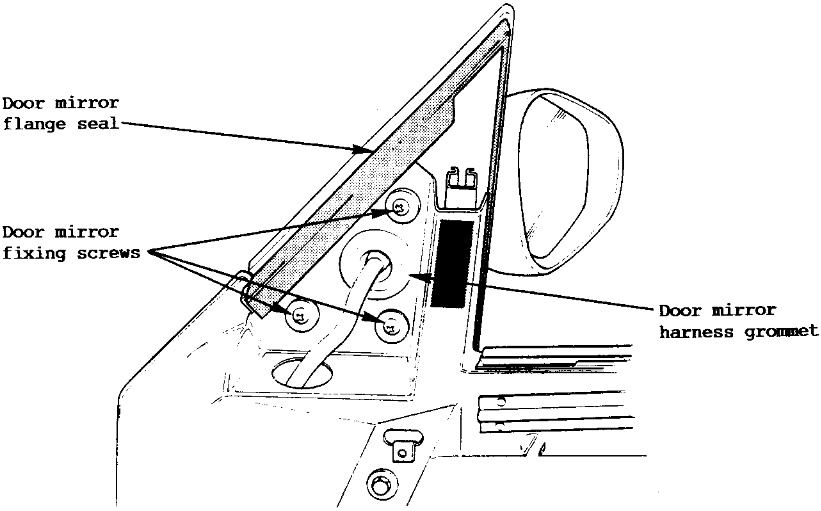
### Removal of Motor/Cable/Channel Assembly

1. Remove the door glass (see above), and motor dripshield.
2. Release the single fixing nut securing the top of the lift channel to the door, and the single nut securing the bottom of the lift channel to the mounting bracket.
3. Release the three nuts securing the motor to the door, disconnect the wiring harness, and withdraw the complete assembly through the front access hole.

Refit in reverse order.

## BK.5 - DOOR MIRRORS

The door mirrors are mounted to the doors via a spring pivot which enables the mirrors to move forwards or backwards on accidental contact, and then return to their former position.



To remove a mirror assembly, remove the door trim panel, disconnect the mirror harness, and release the three screws securing the mirror assembly to the door shell.

To refit a door mirror:

1. Check that the seal is fitted over the mirror flange on the door shell before feeding the mirror harness connector plug through the flange and into the door shell. Locate the harness grommet into the hole in the flange.

2. Retain the mirror using the three M4 screws and washers, and tighten to 2 Nm (18 lbf.in).

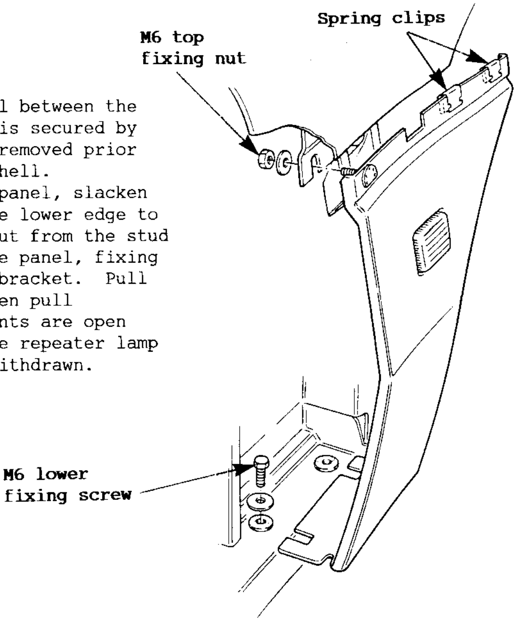
3. Plug in the mirror harness connector to the door harness, and locate the harness clip in the door shell hole.

4. Refit the door trim panel.

## BK.6 - 'A' POST PANELS

The exterior body panel between the door and front wheelarch, is secured by three screws, and must be removed prior to removing the front topshell.

To remove an 'A' post panel, slacken the two screws securing the lower edge to the sill, and remove the nut from the stud at the top rear edge of the panel, fixing the panel to the topshell bracket. Pull out the lower edge, and then pull downwards. All fixing points are open slots. Disconnect the side repeater lamp harness, as the panel is withdrawn.



## BK.7 - FRONT TOPSHELL

The front topshell is a composite moulding comprising of both upper front wings and the bonnet landing platform. A fresh air intake duct is incorporated in each side of the topshell, but is fettled only for right or left hand drive. The topshell is secured by 19/21 threaded fasteners, and may be removed for improved access during engine removal etc.

### Topshell Removal

1. Disconnect battery.

2. Remove the front bumper/spoiler (see BK.8).

3. Disconnect the windscreen washer tubing, unbolt the bonnet from its hinges, and remove the bonnet panel.

4. Remove both lower 'A' post panels by slackening the two screws securing the lower edge to the sill, and removing the nut from the stud at the top rear edge of the panel, fixing the panel to the topshell bracket. Pull out the lower edge, and then pull downwards. All fixing points are open slots. Disconnect the side repeater lamp harness (non-USA cars), and push the harness with its grommet through the bulkhead.

5. Remove both front wheelarch liners, and remove the chargecooler outlet pipe between chargecooler and plenum intake hose. Disconnect the air intake duct from the bulkhead adaptor on the passenger side.

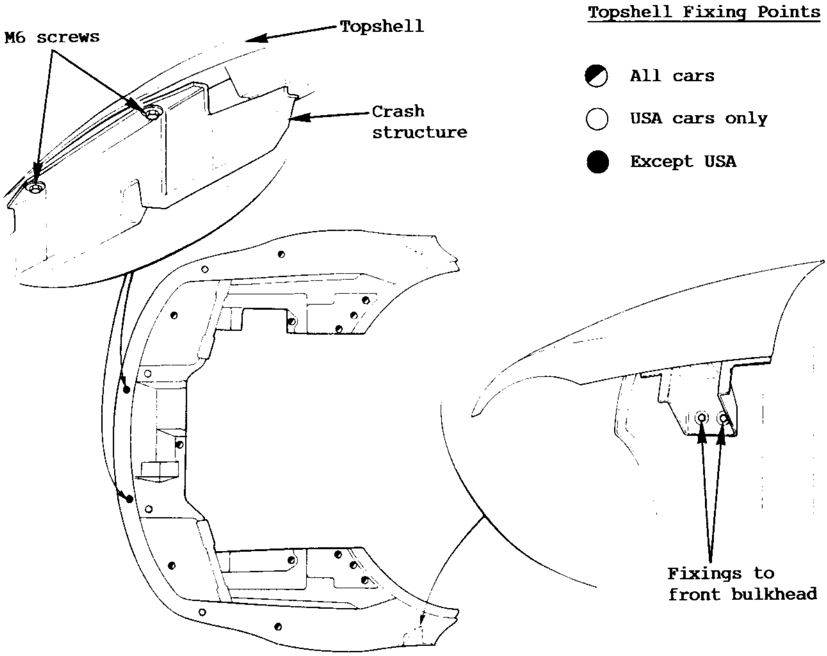
6. At each headlamp motor, disconnect the actuating link, unplug the harness connectors, and remove the bolt securing the topshell reinforcing bracket to the top of the motor. Via the access holes in the wheelarch, remove the two bolts securing the motor to its mounting bracket and remove the motor. Remove the three bolts securing each headlamp motor mounting bracket to the chassis.

7. At the right hand side, disconnect the boost gauge transducer hose. At the left hand side, **label** and disconnect the vacuum hoses to the vacuum solenoid valves for EGR and evaporative emissions (USA cars).

8. Release the bonnet latch mechanism from the topshell.

9. Release the following harness connections:
- main harness connector block at each side rear end;
- earth leads from the bonnet hinges, and push the leads through the topshell;
- earth lead to chassis longeron in each wheelarch;
- horns, behind oil cooler;
- radiator fan harness connector (behind left hand pod well);
- vacuum solenoid valve connectors (label) at left hand side;
- two connectors to the receiver drier pressure switch;
- two single bullets in the reverse light switch harness;

10. Release the topshell fixings:
- two screws beneath each rear end securing the topshell to the front bulkhead. Note any spacers fitted;
- two screws at each side securing the top rear edge to the body near the base of the windscreen;
- one screw each side into the top of the suspension turret;
- one screw each side ahead of the suspension turret;
- one screw each side in the headlamp pod well;
- on USA cars, one screw each side, just inboard of the headlamp pod well.
- one central screw behind the bonnet latch.
- on USA cars, release the front of the wheelarch liners, and release the adjustable brackets securing the topshell to the radiator ducts.
- on USA cars, release the setscrew, nut and rubber washer securing the front of each ventilation duct on the topshell to the top of the radiator ducts.
- on non USA cars, two screws through the front flange of the composite crash structure (mounted on the chassis front frame) into the underside of the topshell front edge.



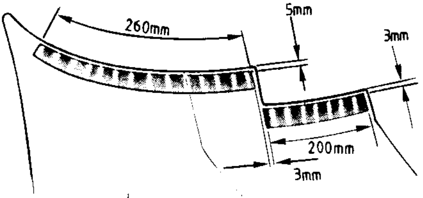
11. Use a sharp blade to cut the Sikaflex adhesive along the topshell rear edge at the base of the windscreen. With the aid of an assistant, lift the topshell up and off the car, taking care not to allow the panel to twist excessively. Take care to note the position and number of spacer washers fitted at any of the fixing points.

Topshell Fitment

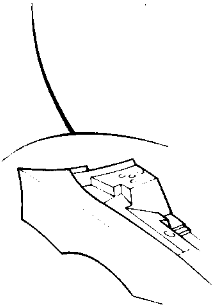
Reverse the removal procedure, noting the following points:

- Check that the anti-chafe self adhesive foam strips are fitted to the underside of the topshell top edge. If necessary fit new foam, cut from A082U6067V, as shown in the diagram.
- Ensure that the topshell harness is fitted correctly to the underside of the topshell;
- Check that the bonnet release cable is fitted into position and connected to the latch mechanism;
- Adjust the rear ends of the topshell to align with the front edges of the doors;
- At each fixing point, examine the gap between topshell and chassis, and fit spacer washers as necessary to avoid any stressing of the composite panel, which could result in the promotion of gel cracks;
- Apply a thread locking compound to the topshell fixing screws.

Check that there is sufficient clearance between the cut out at the back of the RH pod well and the PAS hose. Re-fettle if necessary.


260mm
5mm
3mm
200mm
3mm

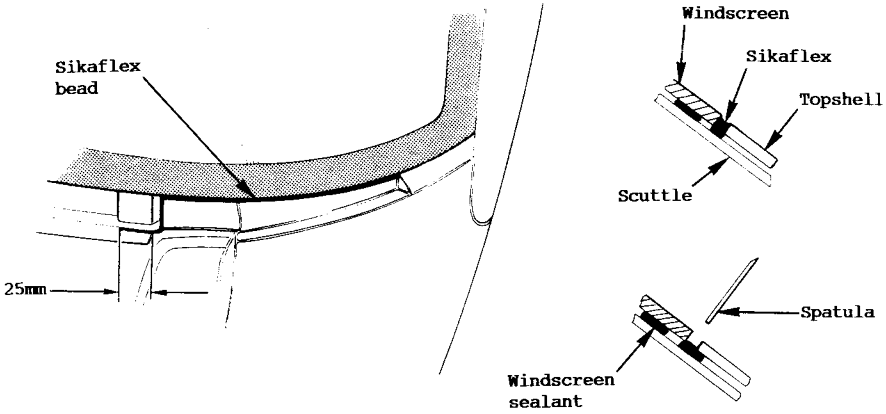
## Fitment of foam strips to underside of topshell



- The final operation is to seal each top rear edge of the topshell to the scuttle:

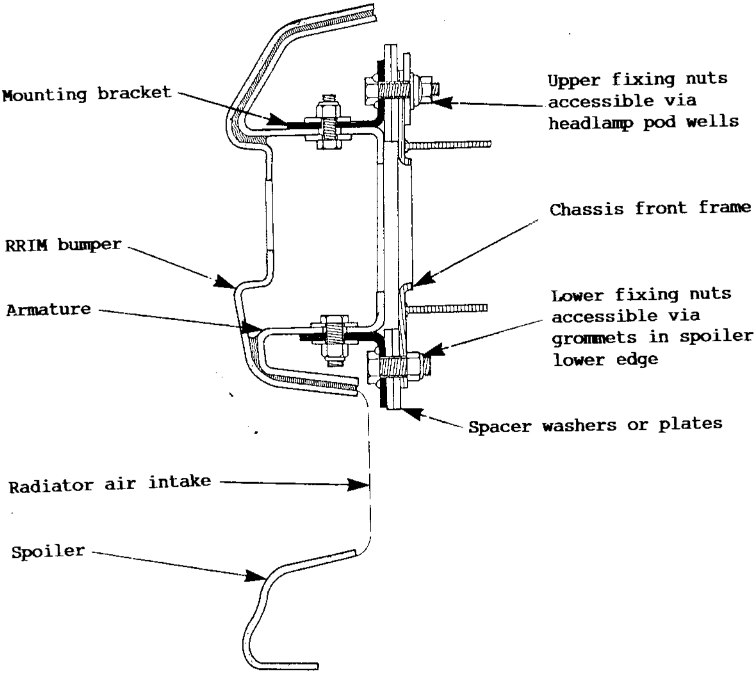
  i) At each side of the car, mask off the lower edge of the windscreen and the visible face of the topshell adjacent to the windscreen base.

  ii) Apply a bead of Sikaflex (A089B6174V) between the screen and topshell as shown in the diagram, and use a spatula to push the sealant down into the gap. Smooth off for a neat finish. Use only a minimal amount of sealer, or subsequent topshell removal will be made difficult.


Sikaflex bead
25mm
Windscreen
Sikaflex
Topshell
Scuttle
Spatula
Windscreen sealant

## BK.8 - FRONT BUMPER/SPOILER

The front bumper/spoiler consists of a Reinforced Reaction Injection Moulding (RRIM) which is bonded to a stiffening and shock absorbing composite armature. The armature is fitted with mounting brackets which locate in two fixing holes at each front corner of the chassis front frame. On USA specification cars, an energy absorbing expanded aluminium honeycomb is bonded to the front frame, and fills the space between the chassis and bumper armature. USA models also include energy absorbing foam between the armature and RRIM cover. The bottom of the spoiler wraps underneath the oil cooler and chargecooler ducts, and a rubber skirting strip is fixed around the lower edge. The rear ends of the bumper are fixed to the side radiator ducts, and provision is made, via adjustable brackets, for controlling the gap between the bumper rear ends and the topshell. Mesh grilles are fitted in each of the three air intake apertures in the spoiler, and are secured using Betaseal polyurethane adhesive. The front side/turn lamps, and side marker lamps on USA cars, are fitted into recesses in the bumper.


Mounting bracket
Upper fixing nuts accessible via headlamp pod wells
Chassis front frame
RRIM bumper
Armature
Lower fixing nuts accessible via grommets in spoiler lower edge
Spacer washers or plates
Radiator air intake
Spoiler

To Remove

1. Release the fixings securing the lower edge of the spoiler to the front undershield and radiator ducts.

2. Release the front of the wheel arch liners to permit access to the bumper rear end fixings. At each side, remove the two M6 screws securing captive nuts in the ends of the bumper armature, to the rear ends of the radiator

ducts. On non-USA cars, release the height adjustment bracket from the top edge of the bumper rear ends.

3. For access to the two lowermost bumper main fixing nuts, pull out the access grommet from the underside of the spoiler at each side, and reach up to the M8 fixing nut behind the flange on the chassis front frame.

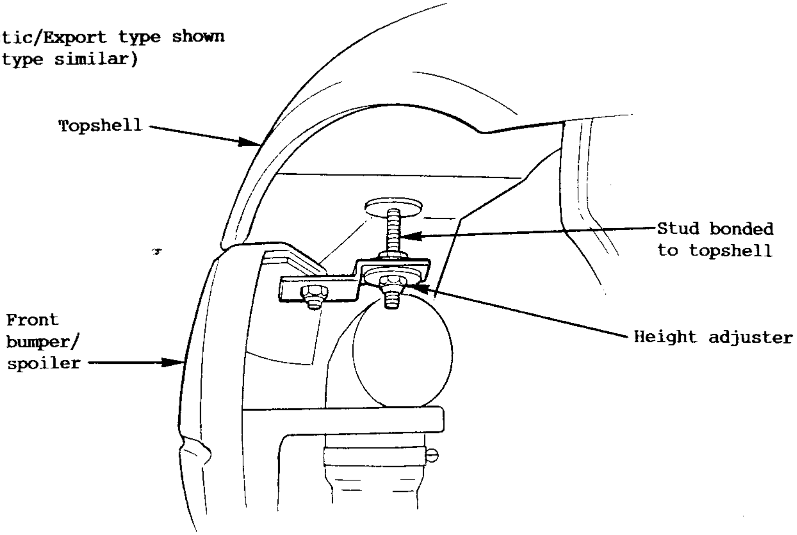
4. The two top bumper fixings are accessible at the front of the headlamp recesses, with the headlamps raised.

5. Withdraw the bumper assembly sufficiently to disconnect the side/turn lamp and side marker lamp harnesses.

To Refit

When refitting a bumper assembly, fit spacer plates or body washers onto the four main fixing studs as required in order to achieve correct alignment (5mm gap) with the topshell front edge. Reverse the removal procedure, using the height adjuster brackets at each rear end to control the gap between the bumper and topshell before tightening the bumper to rad. duct fixings.

**Domestic/Export type shown (USA type similar)**



BK.9 - REAR BUMPER

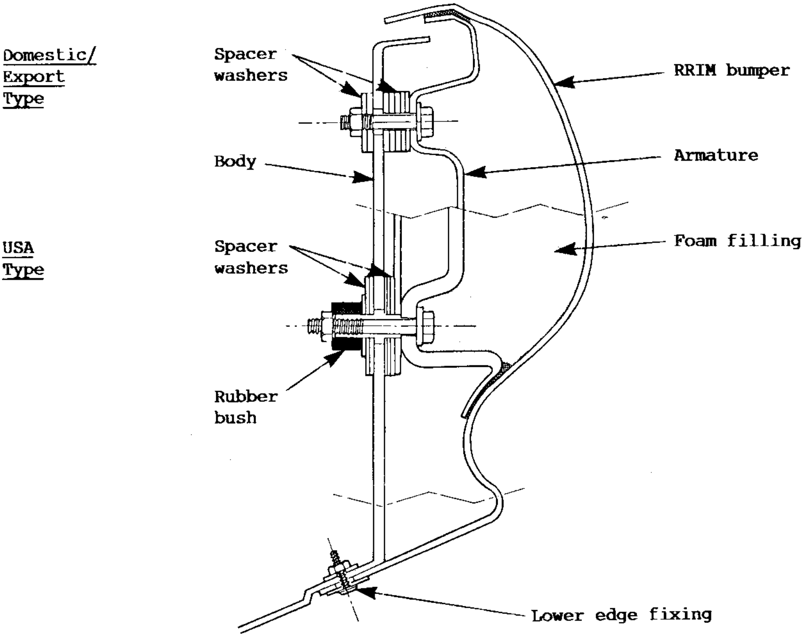
The rear bumper is a Reinforced Reaction Injection Moulding (RRIM), bonded to a stiffening and shock absorbing composite armature. The armature is bolted to the rear of the body undertray with four bolts. On USA specification cars, a stronger armature is used, and the space between the armature and bumper is filled with energy absorbing foam. The mounting bolts on these cars are fitted with rubber bushes on the inside of the body to provide some compliance and allow the armature to flex on impact.

To Remove

1. On USA cars, at each side, disconnect the side marker lamp harness and release the grommet from the body aperture.

2. Remove the five screws securing the lower rear edge of the bumper moulding to the body.

3. From inside the boot, remove the four fixing nuts with spacer washers and, on USA cars, rubber bushes, and withdraw the bumper assembly.



To Refit

1. Check that the four mounting bolts are securely fixed in the bumper armature.

2. Domestic & Export: Place 5 spacer washers onto each bolt and fit the bumper to the body. Fit a foam sealing washer and 2 spacer washers on the inside of the body and finger tighten the M8 fixing nuts.

3. USA Specification: Check that the spacer tube/plates are securely bonded to the armature. Place 3 spacer washers over each tube, and fit the bumper to the body, feeding each side marker lamp harness through the body. Fit a foam sealing washer and 2 spacer washers on the inside of the body, followed by a ½" washer, the rubber bush, an M8 washer and the nut, finger tightened.

4. Check the alignment of the bumper with the rear body and wheelarches, and if necessary remove the bumper and transfer spacer washers from inside to outside, or vice-versa, but retain a total of 7 (Domestic & Export) or 5 (USA specification) spacer washers on each bolt.

5. When alignment is satisfactory, torque tighten the four nuts to 16 - 20 Nm (12 - 15 lbf.ft).

6. Refit the 5 screws and washers securing the lower edge of the bumper to the body.

7. USA Specification: Engage the side marker lamp grommets in the body apertures, and connect the harnesses.

## BK.10 - BONNET PANEL

The bonnet panel consists of an inner and outer composite moulding, bonded together, with the assembly hinged at each rear corner to the front topshell. A bonnet prop is mounted at the front of the bonnet, and may be inserted into a slotted bracket on the topshell at the front of the engine bay. The single bonnet latch is located centrally at the front edge, and is operated by cable from a release lever mounted on the driver's side door hinge post. Radio screening foil is sandwiched between the underside of the bonnet panel and the sound insulation foam, and is earthed at each side via the bonnet hinges and an earthing braid to the chassis.

### Adjustment

- the height of each rear corner may be adjusted by the insertion or removal of shim plates at the bonnet hinges;
- the hinge to bonnet panel mounting holes are slotted to allow adjustment of shutlines;
- rubber buffers are mounted in the topshell behind each headlamp pod well for each front corner of the bonnet, and may be adjusted for height;
- the bonnet latch striker pin may be screwed up or down to adjust the height of the bonnet front edge.

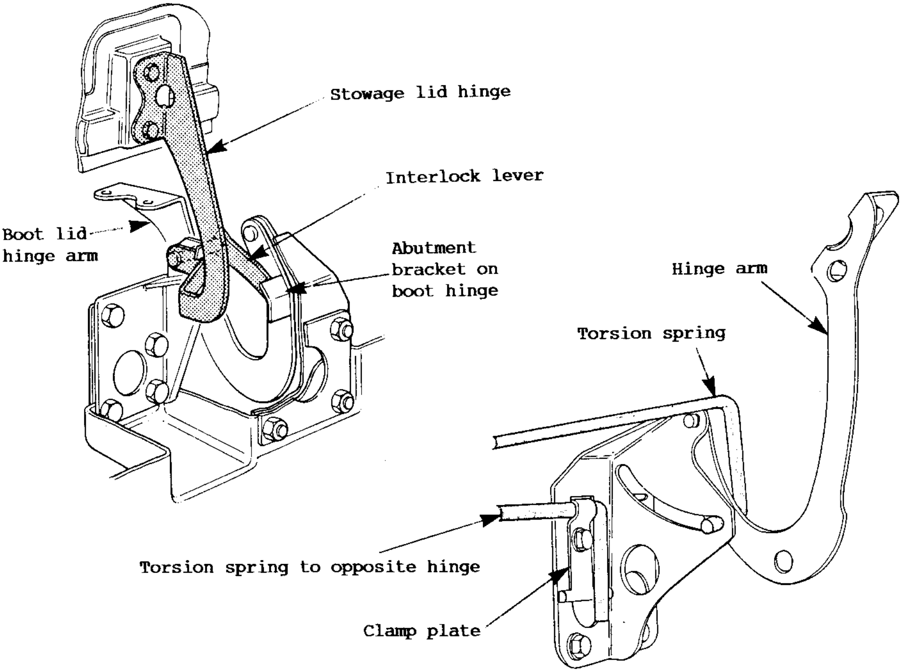
### Release Cable

The bonnet release cable runs forward from the release lever on the driver's side door hinge post, through the bulkhead, along the underside of the front topshell to the bonnet latch, where it is fitted with a solderless nipple. To release the cable from the latch plate, the plate should be released from the topshell, and withdrawn through the access tunnel towards the engine.

## BK.11 - BOOT LID

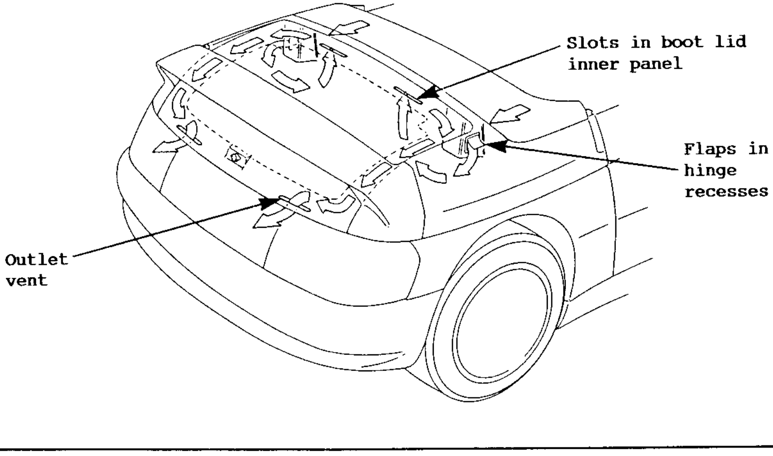
The boot lid consists of inner and outer composite mouldings which are bonded together, and a seperate, bolted on spoiler of similar construction. The spoiler is secured to the boot lid using two M6 fixings at each side. The boot lid is hinged at its forward edge, and uses two simple, torsion spring assisted hinges secured via hinge brackets to the rear bulkhead. A torsion spring is clamped to each of the hinge brackets, and engages into the opposite hinge arm to provide opening assistance and support the lid in the fully open position. Four bolts secure each hinge bracket to the bulkhead via a loose tapping plate in the roof stowage compartment.

The pivot pin of each roof stowage lid hinge passes through the rear bulkhead, and an interlock lever mounted onto this pin abuts against the boot lid hinge arm when either the stowage lid or boot lid is open. This feature prevents the possibility of lid to lid clash, by ensuring that only one of the lids may be fully opened at any one time.


Stowage lid hinge
Interlock lever
Boot lid hinge arm
Abutment bracket on boot hinge
Hinge arm
Torsion spring
Torsion spring to opposite hinge
Clamp plate

A hollow section weatherstrip is push fitted onto the body flange edge, with its joint at the centre rear.

When the soft top is raised, air is able to vent from the cabin interior via one way flap valves in the rear bulkhead hinge recesses, into the boot. Ventilation of the boot is achieved by ducting air through the boot lid reinforcing channels to outlets over the rear number plate. Care should be taken not to obstruct the ventilation system with luggage or clothing.


Slots in boot lid inner panel
Flaps in hinge recesses
Outlet vent

Adjustments

The height of the front edge, and the lateral position of the boot lid, is adjusted by moving the hinge brackets up or down, or side to side on the bulkhead.

'Squareness' and the fore/aft position of the lid is adjustable by slackening the bolts securing the slotted hinge arms to the lid. The tapping plates are pop rivetted inside the boot lid double skin. If the lid is too far forward, fouling of the aperture front edge may result.

Rubber buffers are also fitted in the rear topshell at each side, above the rear lamps, and may be adjusted for height to control the rear edge shutlines.

Boot Lid Latch

A single, centrally located latch is fitted to the boot lid, and is operated using the door key. Insert the key into the lock (smooth side to the right), and turn clockwise to lock, counterclockwise to unlock.

The latch mechanism is fixed to the lid inner panel with two screws and a loose tapping plate. The lock barrel is retained in the lid outer panel with a spring clip fitted via a slot in the inner panel rear edge. The striker plate is fixed to the body by a single screw which permits adjustment side to side and up/down. Adjust to achieve secure closing after the adjustments detailed above have been completed.

## BK.12 - ROOF STOWAGE LID

The roof stowage lid consists of an inner and outer composite panel bonded together and hinged at the rear edge via two simple, unassisted hinges to the rear bulkhead. Four bolts secure each hinge bracket to the bulkhead using loose tapping plates in the boot. Each hinge arm is fixed to the lid by two M6 screws and tapping plates pop rivetted inside the inner skin.

The pivot pin of each roof stowage lid hinge passes through the rear bulkhead, and an interlock lever mounted onto this pin abuts against the boot lid hinge arm when either the stowage lid or boot lid is open. This feature prevents the possibility of lid to lid clash, by ensuring that only one of the lids may be fully opened at any one time (see drawing in section BK.11).

To remove a stowage lid hinge bracket, release the hinge arm from the lid, and from inside the boot, release the spring clip securing the interlock lever to the pivot shaft extension. Pull the interlock lever off the pin, slide out the hinge arm, and unbolt the hinge bracket from the bulkhead.

Adjustments

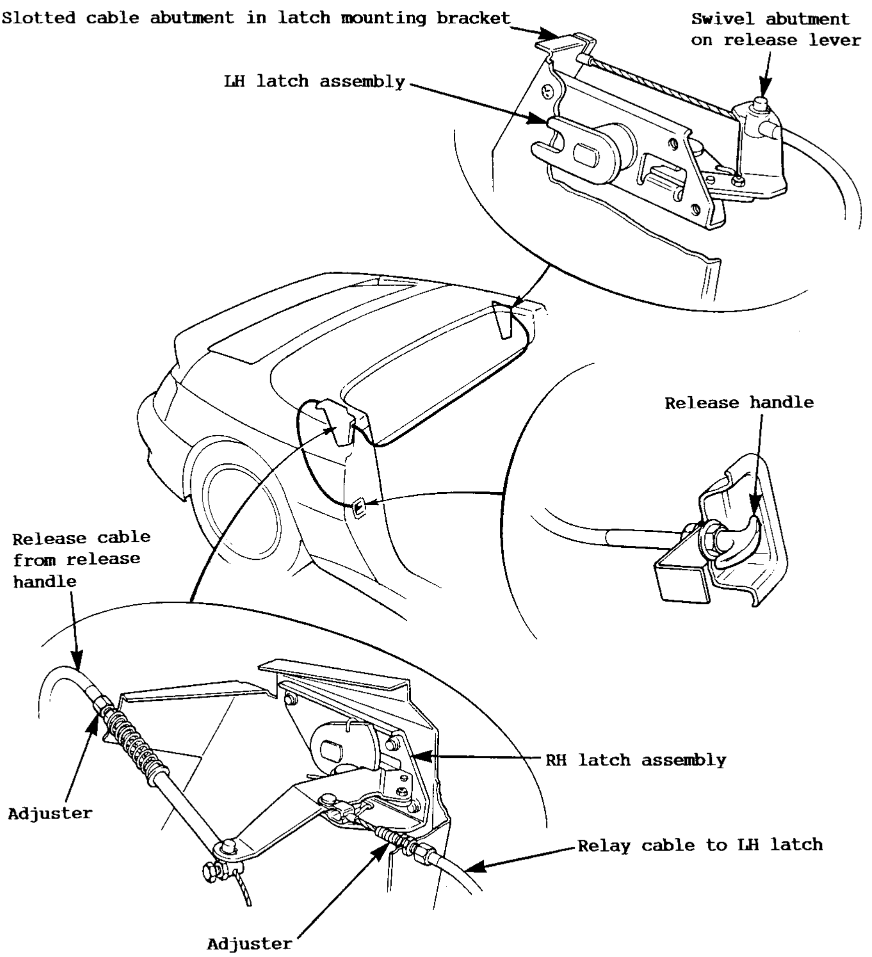
The height of the rear edge of the lid, and the lateral position, is adjustable via the hinge bracket to bulkhead fixings. 'Squareness' and fore/aft position is adjusted at the lid to hinge arm fixings.

Latches

Two types of latching mechanism have been fitted.

EARLY TYPE:

A cable operated latch is fitted at each side of the lid aperture, with the release handle mounted in the right hand door jamb. The cable runs from the handle to the right hand latch release lever, to which is fitted a second cable which runs to the left hand latch, abutting against the release lever, before being anchored to the latch bracket. Pulling the release handle releases both latches, and allows the lid to be raised by hand. When closing the lid, press firmly over each side to fully engage both latches.

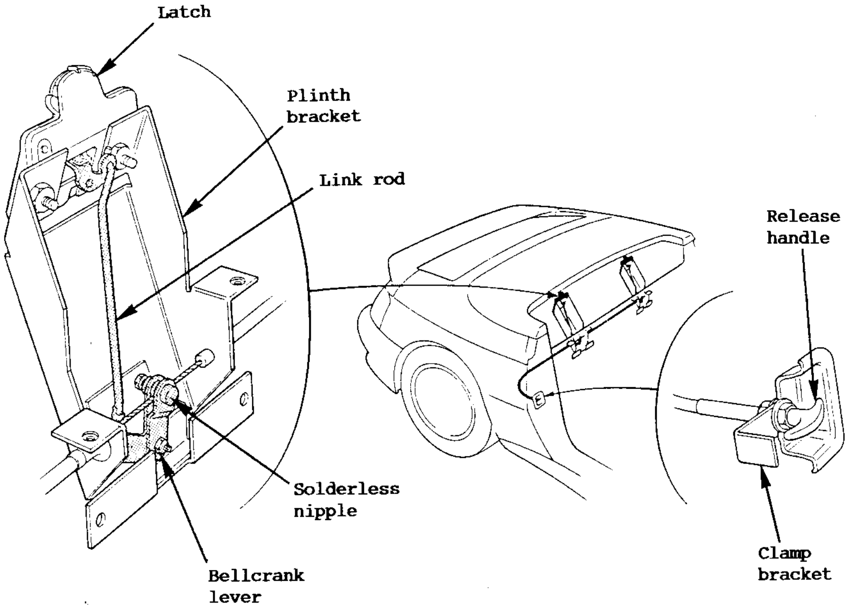

Slotted cable abutment in latch mounting bracket
Swivel abutment on release lever
LH latch assembly
Release handle
Release cable from release handle
RH latch assembly
Adjuster
Relay cable to LH latch
Adjuster

Each latch is mounted on a bracket fixed to the seat belt reinforcing strut and to the edge of the body aperture. The striker plates are fixed to the stowage lid by two screws and captive tapping plates. The striker plates may be adjusted fore/aft via slotted fixing holes, and the panel shut height adjusted by adding or deleting shims between the strikers and lid. Slack may be removed from both cables via adjusters provided at their abutments on the right hand latch.

The handle assembly may be removed by releasing the nut and clamp plate behind the 'B' post.

LATER TYPE:

Later cars use two latches mounted on plinth brackets bolted to the top of the roof stowage compartment front wall. The two latches are operated by a single cable with a handle provided in the right hand door jamb. The cable connects with a bellcrank lever at the base of the right hand plinth, before continuing across to the left hand plinth. At each plinth, a bellcrank lever transfers the motion of the cable up to the latch via a short link rod. To adjust the cable, remove the trim panels from the latch plinths, and adjust at the bellcrank lever solderless nipples.

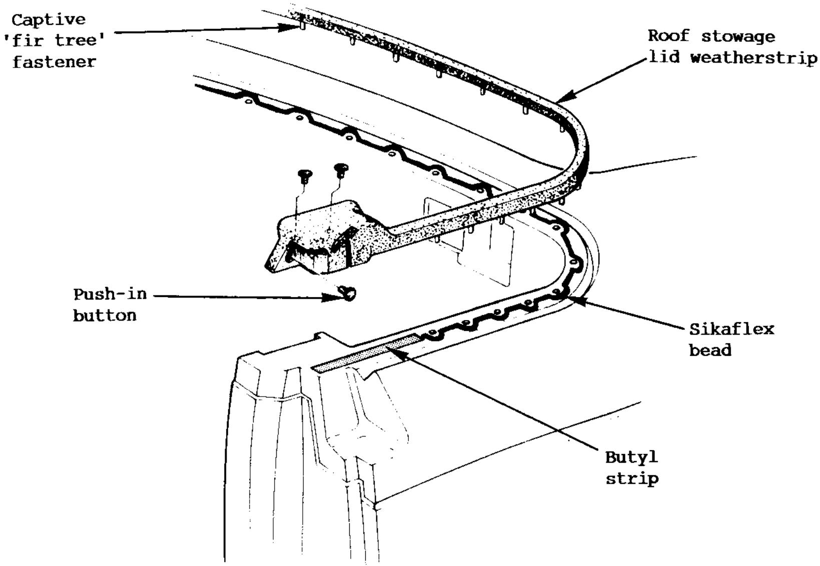


At the handle end of the release cable, early cars used a separate plastic recess moulding clamped into the 'B' post as shown in the illustration, but later cars have the recess moulded as part of the body panel.

Weatherstrip

A closed cell moulded foam weatherstrip seal is fitted around the body aperture. To remove the seal, prise out the buttons securing each end of the seal, and carefully peel back each end from the butyl strip securing the seal to the body. Use a scalpel to cut the Sikaflex adhesive used along the remainder of the seal and withdraw each of the seal fixing 'fir tree' fasteners, captive within the seal.

To fit a new seal, clean the flange on the body before applying a bead of Sikaflex 221 (approx 4mm wide by 3mm high) along the seal path, from the first


Captive 'fir tree' fastener
Roof stowage lid weatherstrip
Push-in button
Sikaflex bead
Butyl strip

push-pin hole on one side, to the first hole on the other side. The bead should run around the outside of each of the push-pin holes. Fix a length of butyl strip A100B6156 from the end of the seal mounting path to the first push-pin hole. Fit the weatherstrip seal into position, pushing the retaining pins fully into the holes, and fit the buttons securing each end of the seal.

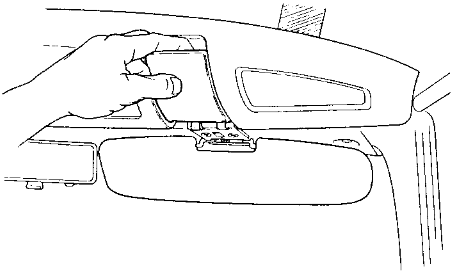
Check that a 900mm length of foam strip A082U6067 is fitted to the seal path on the stowage lid between the hinges.

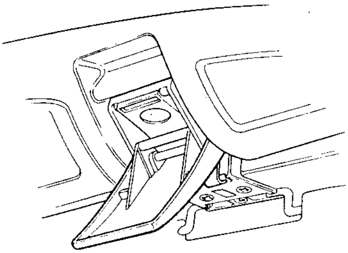
## BK.13 - SOFT TOP ROOF

To Lower:

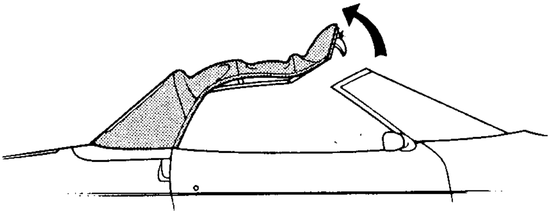
i) Transfer any bulky items from the rear shelf to the boot, and close the boot lid. Lower the door windows.

ii) Release the two over centre latches at the windscreen header rail by pulling down the latch handles, and releasing the hooks from the header rail.

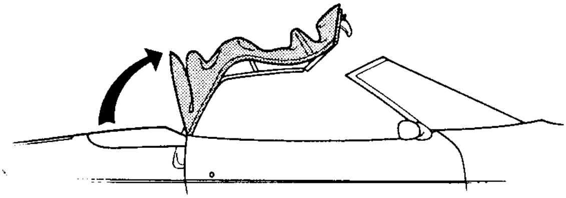




iii) Pull back the front of the soft top to release the tensioning mechanism.

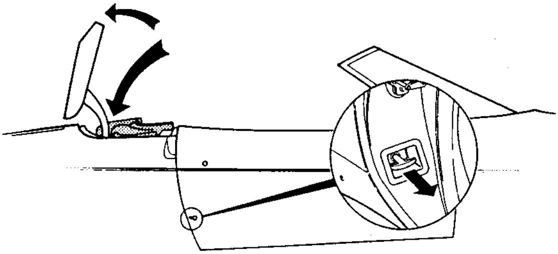


iv) Lift up the rear edge of the soft top whilst assisting the rear window to fold inwards in one smooth fold.



v) Release the roof stowage lid by pulling the release handle in the right hand door jamb and raise the lid fully.

vi) Fold the soft top down into the stowage compartment by pushing back on the front edge. Secure the roof by buckling the retaining strap (if fitted).



vii) Close the stowage lid, pressing firmly over each catch to ensure their full engagement.

To Raise:

i) Close the boot lid and lower the door windows.

ii) Release the roof stowage lid by pulling the release handle in the right hand door jamb.

iii) Raise the lid fully, unbuckle the retaining strap (if fitted), and pull out the soft top in its folded state, from the stowage compartment.

iv) Raise the rear edge of the soft top and close the stowage lid, pressing firmly over each catch to ensure their full engagement.

v) Push down the back edge of the soft top, and pull the front edge to the windscreen header rail.

vi) At both of the header rail latches, engage the hooks of the latch into the recesses on the header rail brackets, and push the latch handle fully upwards and back.

It is not recommended that the soft top be stowed for long periods when wet, as degradation of the fabric will be accelerated. Before stowing a wet soft top, wipe over with a soft cloth or sponge to remove most of the water, and raise the roof after the journey to allow the material to dry off.

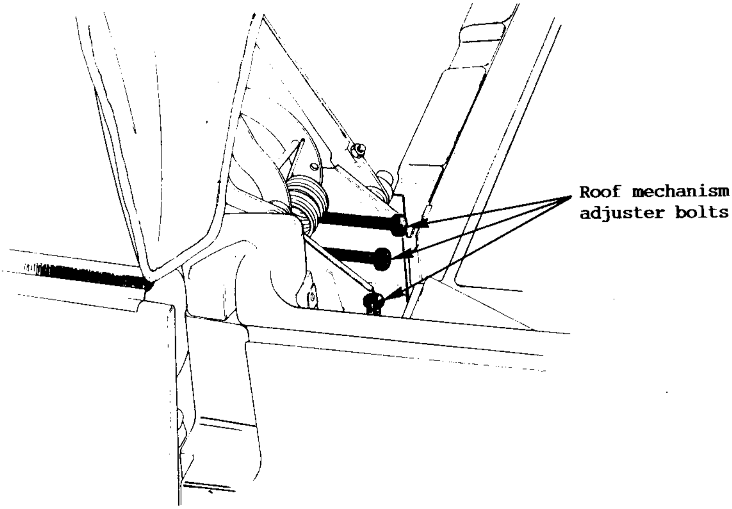
**CAUTION:** Lotus does NOT recommend that the Elan is subjected to a mechanical (automatic) car wash. Some types of brushes used in these devices may cause scratching of the flexible rear window, and accelerated ageing of the roof fabric. The soft top and rear window should be washed using only warm soapy water. Do NOT use any sort of proprietary cleaner, or rub with a dry cloth. Rinse with clean water and wipe with a soft cloth or sponge to remove the surface water. Allow to dry off before stowing.

## Fitting & Adjustment of Roof Assembly

The only adjustments that may be made to the soft top roof assembly, are the fitting position of the roof mechanism in the 'B' posts, and the position of the latch plates on the windscreen header rail. The roof mechanism itself, is adjusted and set at the manufacturers, and no attempt should be made to alter the setting of any part of the mechanism.

The roof assembly is clamped into each 'B' post by two through bolts. Before fitting or adjusting the position of the roof mechanism, first check that the doors are fully assembled and correctly adjusted, and that the windscreen header rail and catches are fitted.

1. Fit the roof assembly mechanism into the 'B' posts, and fit the two retaining through bolts and washer/tapping plates at each side. Fit two long (100 mm) M12 bolts horizontally into the weld nuts at the front of each roof pivot bracket, and one long (80 mm) M12 setscrew vertically into the weld nut at the base of each pivot bracket.



2. Erect the roof, and using the long bolts, position the mechanism in the 'B' posts to achieve:
   - optimum fit of the roof front seal along the header rail; the roof must be centralised, with the seal fitting snugly into the angle of the header rail;
   - sufficient height at the 'B' post so that the top rear corner of the door fits snugly under the roof seal.
   - contact between the roof rear edge seal and the stowage lid from 'B' post to 'B' post.

3. Tighten the four roof mechanism mounting bolts, and remove the long adjuster bolts. Recheck fit of roof.

4. Adjust the position of the two latch plates on the header rail for optimum alignment with the roof latches, and tighten the fixing bolts.

Roof Weatherstrip Replacment

Various weatherstrip seal kits for the roof are available. See Service Parts List for details.

## BK.14 - HEADLAMP MECHANISM

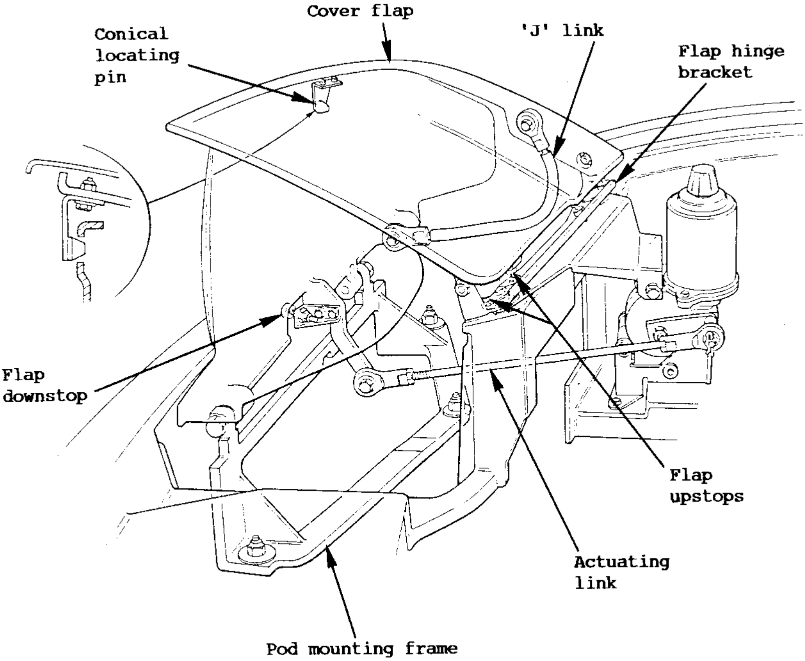
Two types of headlamp mechanism have been used. Cars prior to VIN 6300 were fitted with 'fold back' (or 'opera glass') headlamps, where the headlamp pod was pivotted at its front lower edge and used a separate cover flap to conceal the retracted headlamps. Later cars use a 'single pivot' mechanism with a top rear edge pivot for the headlamp pod, whose top surface forms the body profile when the headlamps are retracted.

### Fold Back Type Headlamp Mechanism

The retracting headlamp mechanism consists of a pair of headlamps at each side of the car mounted on a pivoting frame which, when the headlamps are not in use, allows the lamps to fold down backwards, under the control of an electric motor, and be concealed by cover flaps.

The system comprises the following principal components at each side of the car:

- Headlamp Pod; Aluminium alloy casting carrying a pair of headlamps and pivoted to the pod mounting frame. Operated by the headlamp motor actuating link, and drives the cover flap 'J' link. On very early cars, the headlamp pod was a composite moulding fixed to an aluminium alloy hinge bar by three screws.
- Pod Mounting Frame; Aluminium alloy casting, bolted to the base of the topshell pod well via three big head studs. Carries the pivot bushes for the headlamp pod.
- Headlamp Cover Flaps; Cast aluminium alloy inner, and composite outer skin panel painted body colour. Pivoted via two ball joints to a hinge bracket on the topshell. Operated by an adjustable 'J' link from the outboard side of the headlamp pod to rise in conjunction with the pod. Incorporates a conical interlock pin at the centre of the front edge, to engage with a hole in the top front of the headlamp pod when raised. This feature adds rigidity to the assembly when in the raised position, and reduces 'flutter'.
- Flap Hinge Bracket; Steel bracket bolted to topshell. Anchor for cover flap hinges. Incorporates cover flap upstops.
- 'J' Link; Steel link rod with ball joint at each end. Connects the cover flap to outboard side of the headlamp pod.



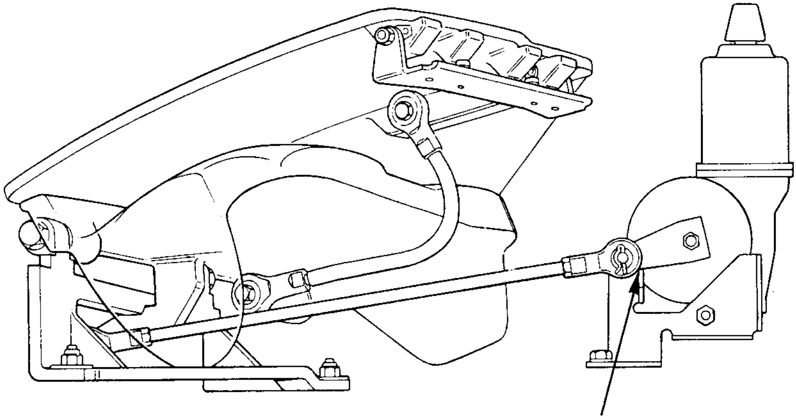
Headlamp Motor and Actuating Link; The reversing electric motor is fixed by two bolts into a mounting bracket, itself secured by three bolts through the topshell to the chassis longeron. The motor rotary link is constrained by two limit stops on the mounting bracket, and is connected by an adjustable length actuating link, fitted with a ball joint at each of its ends, to the headlamp pod. The motor mounting bracket also carries a micro-switch which is closed by the rotary link only in the pod fully raised position. This permits the headlamps to operate only in that position, and prevents dazzle as the pods are rising.

Various adjustments to the headlamp mechanism are required to ensure:
a) consistent shut gaps;
b) satisfactory mechanical operation under all driving conditions.

Adjustment Procedure

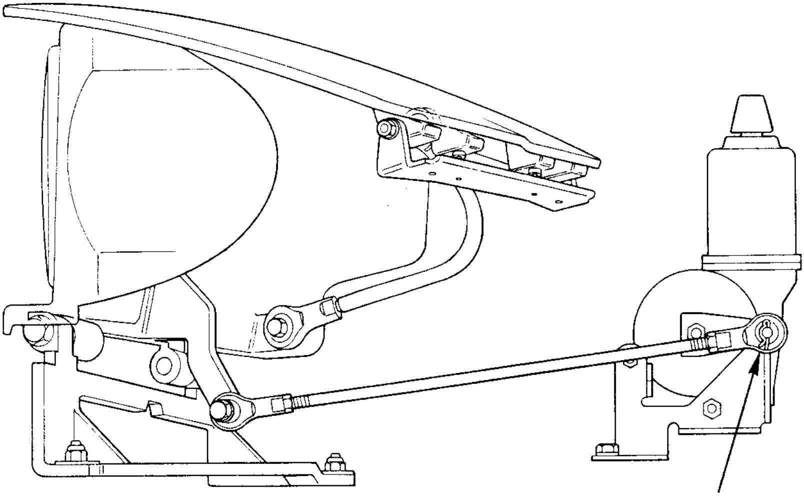
1. Before adjusting the headlamp mechanism, disconnect or remove the following:
   - pod actuating link;
   - cover flap outer panel;
   - cover flap operating 'J' link;
   - conical locating pin at front edge of flap inner;
   - fully screw down the pod upstops in the flap hinge bracket.

## Headlamp Mechanism in Lowered Position



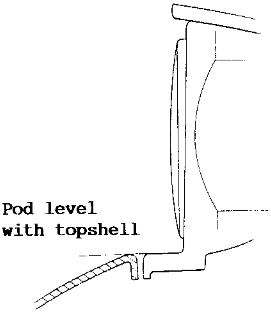
Rotary link against
up stop abutment

## Headlamp Mechanism in Raised Position

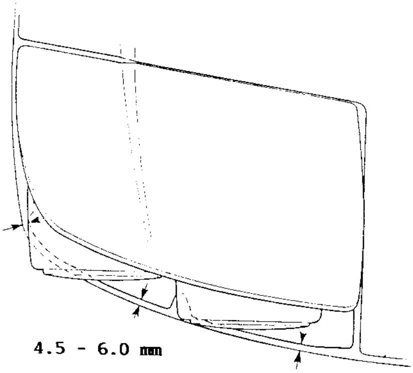


Rotary link against
down stop abutment

2. Pod Pivot Frame: The pod pivot frame is secured to the base of the headlamp pod well by three studs. Hold the pod in the erect position with the headlamp face vertical, and if necessary, slacken the three fixings and re-position the frame to align the front edge of the pod with the topshell.



The shut gap between the pod and topshell should be 4.5 - 6.0 mm. Slotted spacer washers may be inserted or removed at each frame fixing point to adjust the height of the front edge of the pod, which should be level with the top edge of the topshell.



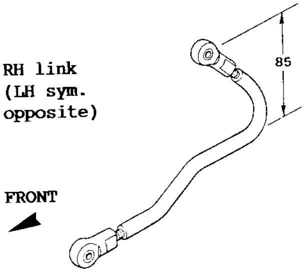
3. Pod Actuating Link: Wind the headlamp motor to the fully up position with the rotary link against the (rear) stop bracket. Adjust and connect the pod actuating link so that the front face of the pod leans forward 1° to 2°.

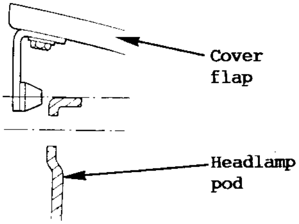
4. Flap Hinge Bracket: Wind down the pod, and shut the bonnet. Place the cover flap outer panel loosely in position and examine the shutlines around the cover flap in relation to the topshell and bonnet panel. If necessary, slacken the two hinge bracket fixings, and move the bracket or add/delete shim washers as required. The flap downstop is adjusted later.

5. Conical Locating Pin: Wind the pod fully up. Fit the locating pin to the flap inner, and centralise in the pod hole. If necessary, move the flap hinge bracket sideways so this can be achieved. Re-check cover flap shutlines. Tighten the locating pin fixings with the pin fully engaged in the pod hole, with the pin bracket abutting against the pod.

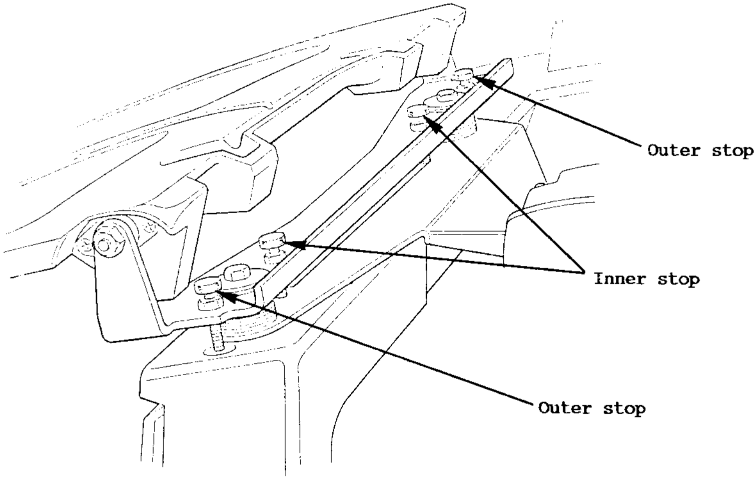
6. To preload the pod against the flap, lower the pod partially and reduce the pod actuating link length by a ½ turn.

7. 'J' Link: Check that the correctly handed link is fitted on each side by referring to the diagram. The flap end of the link should be set to 85mm as shown. To adjust the pod end of the link, wind up the pod until just short of the locating pin and adjust the length of the 'J' link at the pod end, so that when the link is connected, the centreline of the locating pin is level with the top of the pod. Connect the link, then press the front of the cover flap hard down against the top of the pod and screw up all four upstops (in flap hinge bracket) against the cover flap.



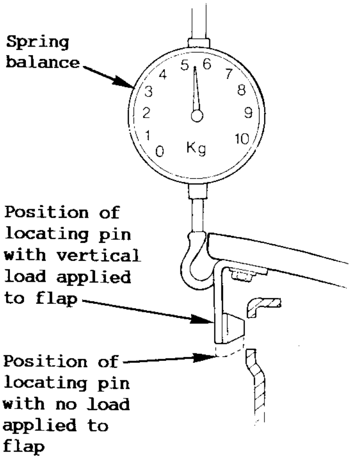


8. Wind down the pod. Apply one full turn counterclockwise to the flap outermost upstops, and a half turn counterclockwise to the innermost upstops. Tighten locknuts.



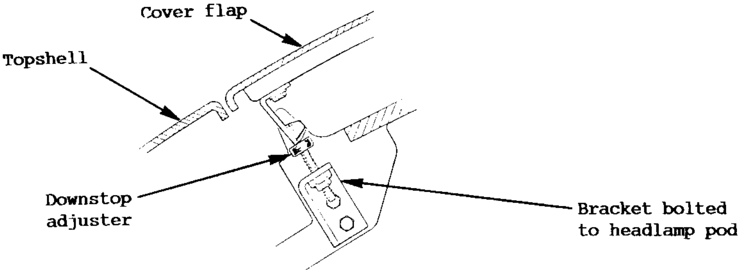
9. Wind up the pod and check that the conical locating pin enters the pod hole. In the vehicle static condition, the pin should enter the hole below its centreline, and engage fully when the pod is fully raised. If the pin is too low to enter the hole, turn all four upstops $\frac{1}{4}$ turn clockwise, and recheck. Repeat if necessary until engagement is achieved.

10. In order to ensure correct operation at high vehicle speed, it is necessary to test for locating pin engagement with an upward load (wind pressure) applied to the cover flap: Lower the pod sufficiently for the locating pin to disengage and attach a spring balance to the flap adjacent to the locating pin. Apply a vertical upward load of 5 to 6 kgf to the flap and wind the pod fully up. The pin should enter the top of the pod hole, and engage fully when the pod is fully raised.
If the pin is too high, adjust the four flap upstops ¼ turn counter-clockwise and recheck. Recheck operation with no flap loading.


Spring balance
0
1
2
3
4
5
6
7
8
9
10
Kg
Position of locating pin with vertical load applied to flap
Position of locating pin with no load applied to flap

11. Fit the outer flap onto the inner, and retain with the four fixings. Adjust the position to obtain 4.5 to 6.0 mm shutlines all around the closed pod before tightening.

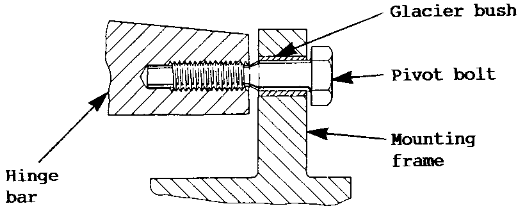
12. Check/adjust the flap front edge downstop to achieve a compatible panel height with the topshell. Check that the left hand motor rotary link does not foul the aluminium a.c. pipes (if fitted).


Cover flap
Topshell
Downstop adjuster
Bracket bolted to headlamp pod

13. Check headlamp alignment using a beamsetter.

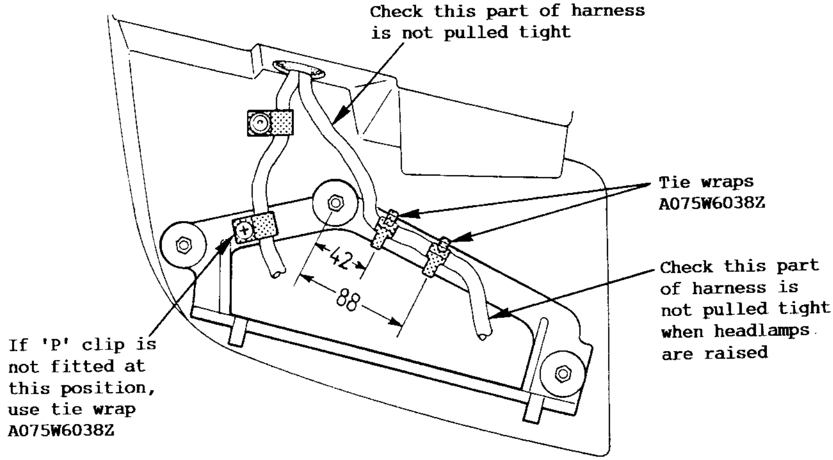
Headlamp Pod Pivots

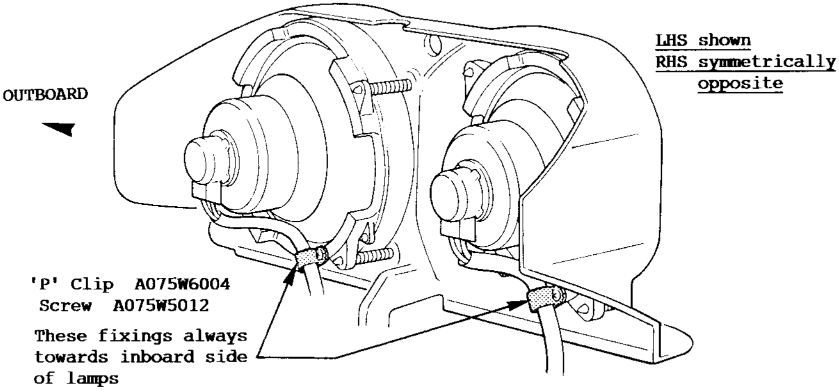
Each headlamp pod uses two self lubricating Glacier 'DU' pivot bushes, pressed into the headlamp mounting frame, and pivot bolts passing through the bushes into tapped holes in pod. The pivot bolts have a spigot on the threaded end which bottoms out in a counterbore in the pod tapping, to provide a means of tightening the bolts in position. The mounting frame straddles the headlamp pod to provide lateral location, and no shimming, adjustment or lubrication of the pivot mechanism is required.


Glacier bush
Pivot bolt
Mounting frame
Hinge bar

Headlamp Harness Routing

It is most important that the headlamp harness is routed and secured correctly to ensure that it is neither strained nor chafed/trapped at any stage of headlamp operation. Refer to the following diagrams for the correct specification.

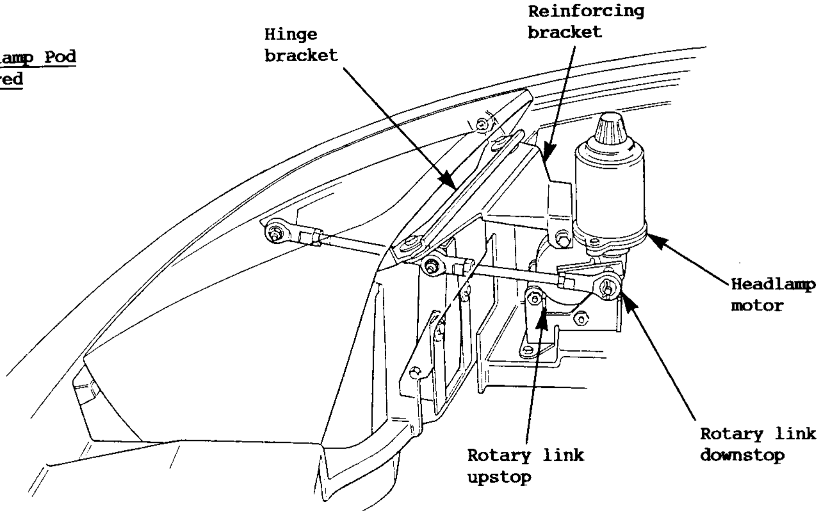

Check this part of harness is not pulled tight
Tie wraps A075W6038Z
Check this part of harness is not pulled tight when headlamps are raised
42
88
If 'P' clip is not fitted at this position, use tie wrap A075W6038Z


LHS shown
RHS symmetrically opposite
OUTBOARD
'P' Clip A075W6004
Screw A075W5012
These fixings always towards inboard side of lamps

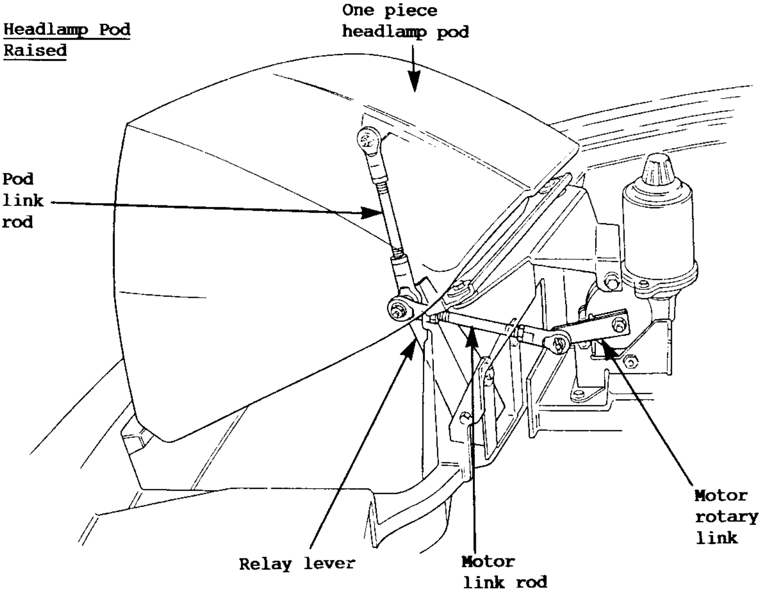
## Single Pivot Headlamp Mechanism

The 'single pivot' headlamp mechanism was introduced at VIN 6300, and uses rear pivoted one piece headlamp pods similar in concept to those used on Excel and Esprit models.

**Headlamp Pod Lowered**


Hinge bracket
Reinforcing bracket
Headlamp motor
Rotary link upstop
Rotary link downstop

**Headlamp Pod Raised**


One piece headlamp pod
Pod link rod
Relay lever
Motor link rod
Motor rotary link

The system comprises the following principal components at each side of the car:

- Headlamp Pod; Carries one main beam headlamp (inboard) and one dip beam headlamp (outboard). Reinforcing plate bonded to pod underside carries two pivot ball joints.
- Hinge Bracket; Bolted to topshell. Anchor for pod pivots.
- Headlamp Motor; Mounted via a bracket to the chassis longeron. Bracket incorporates two travel limiting stops for the motor rotary link. A reinforcing bracket ('shear plate') braces the pod mounting plinth on the topshell to the motor body.
- Operating Linkage; Comprises two link rods and a relay lever. The two link rods are identical and have adjustable ball joints at each end. The relay lever pivots on two ball joints at its base. The ball joints are picked up by an anchor bracket bolted to the bottom rear of the pod well in the topshell.

Operation

When the headlamps are switched on, the headlamp motor operates and the rotary link moves forwards until it contacts the upstop, when the motor stalls and switches off. In the up position, the pod link and the relay lever form an almost straight load path to hold the pod steady.

Electrical control is similar to the previous 'fold back' headlamp system except that:

i) the motor connections are reversed;
ii) the rotary link actuated micro-switches are no longer used.

i.e. the headlights operate as soon as they are switched on, rather than only when the pods are fully raised. There is no danger of dazzle during pod operation with the single pivot system.

Adjustment

Three basic adjustments of the pod mechanism are required.

1. Pod Shutlines; To adjust the pod shut height and shutlines, slacken the two bolts securing the hinge bracket to the topshell, and add/delete slotted shim washers as necessary to achieve correct pod height and alignment. Position the pod to achieve a 5mm (approx) shut gap between the pod and topshell/ bonnet.

2. Motor Link; Adjust the length of the link between motor and relay lever to 140 mm between ball joint centres, with an equal amount of thread showing at each end of the link. Tighten the locknuts, ensuring that the two ball joints are parallel to each other. This dimension will ensure that the linkage goes just over centre with the pod raised, to provide a rigid prop.

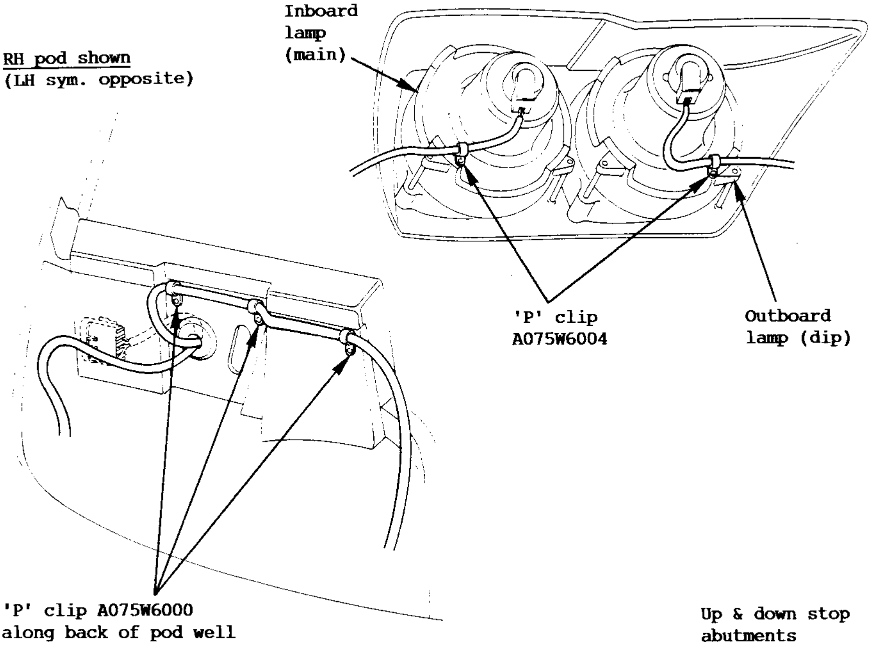
3. With the operating linkage assembled, and the headlamp motor rotary link abutting the down stop, examine the height of the pod front edge. If necessary, adjust the length of the link between relay lever and pod to obtain compatible heights. Tighten the locknuts ensuring that the two ball joints are parallel to each other.

4. With the pods down, check that there is adequate clearance between the right hand pod lower edge and the power steering pump hose at the back of the pod well. If necessary, fettle the edge of the pod to achieve clearance. Also check that the left hand motor rotary link does not foul the aluminium air conditioning pipes (if fitted).

5. Check/adjust headlamp alignment using a beam setter.

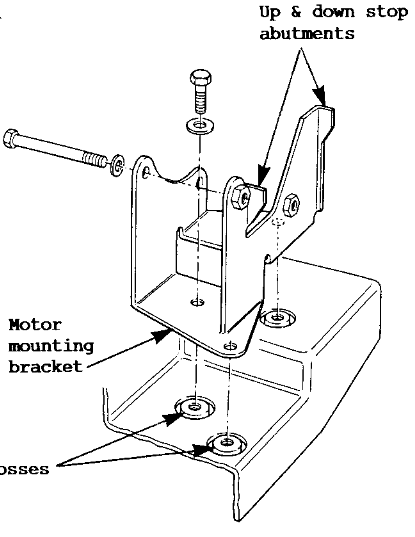
## Headlamp Harness Routing

It is most important that the headlamp harness is routed and secured correctly to ensure that it is neither strained nor chafed/trapped at any stage of headlamp operation. Refer to the following diagrams for the correct specification.


RH pod shown
(LH sym. opposite)
Inboard lamp (main)
'P' clip A075W6004
Outboard lamp (dip)
'P' clip A075W6000 along back of pod well

## Headlamp Motors

Each headlamp motor (for either headlamp system) is clamped in its mounting bracket by two through bolts, accessible from within the wheelarch via holes in the topshell. The topshell reinforcing bracket (shear plate) also bolts to the top of the motor body.
The mounting bracket is secured through the topshell to bosses on the chassis longeron.
For the electrical function of the motors, see section MJ.


Up & down stop abutments
Motor mounting bracket
Longeron bosses

## BK.15 - WINDSCREEN & MIRROR PLINTH

The laminated windscreen is bonded to the high strength aluminium alloy windscreen frame and composite body front bulkhead, using a polyurethane adhesive/sealant, and contributes to the rigidity of the body structure. In order to maintain the integrity of this joint, it is necessary to follow this procedure in detail, paying particular attention to the cleaning and priming operations using materials supplied with Betaseal Kit A075B6158J.

If the windscreen is to be removed/replaced, it will also be necessary to replace the following parts:

- Windscreen edge finishers (top and sides, plus corner caps);
- Screen pillar weatherstrips;
- Interior mirror mounting plinth.

### Precautions

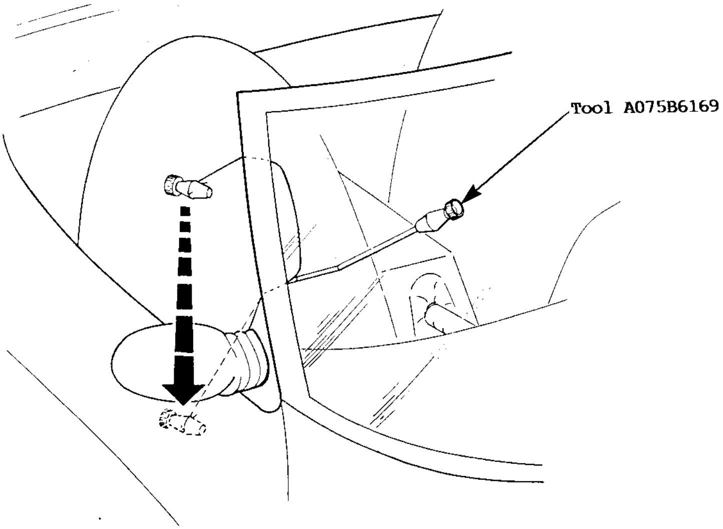
Avoid skin or eye contact with the Betaseal adhesive, and inhalation of the vapour from the cleaners or primers. High concentrations of the vapours are noxious - use in conditions of good ventilation. Flash point 12 - 15°C.

### Windscreen Replacement

1. Remove both windscreen wiper arms.

2. Remove the screen pillar interior trim and header rail trim panels (see section VD).

3. Remove the screen pillar weatherstrips, by prising out the retaining buttons at the top and bottom of each seal, and peeling out of the carrier channel on the screen pillar. Since the weatherstrips are sealed with Sikaflex adhesive, they are unlikely to be removed undamaged, and should be replaced. Remove the weatherstrip carrier channels after releasing their retaining screws.



4. Bore a small hole through the windscreen edge finisher and Betaseal bead, and insert a length of piano wire or similar (supplied in Betaseal Kit) approx. 1 metre long, through the hole. With the aid of an assistant inside the car, use a sawing action to cut through the Betaseal and free the screen from the car. Alternatively, use wire cutting tool A075B6169 or a proprietary hot knife cutting tool. Take great care not to damage the interior trim or paintwork during this operation. If using a cutting wire, beware of snagging the wire in the joints between header rail and screen pillars.

5. Remove excess Betaseal from the screen aperture with a sharp blade. Note that it is not necessary to remove all traces of the sealant, but a uniform surface must be available for bonding the new screen. Do NOT abrade the bonding surface on the alloy windscreen frame or body.

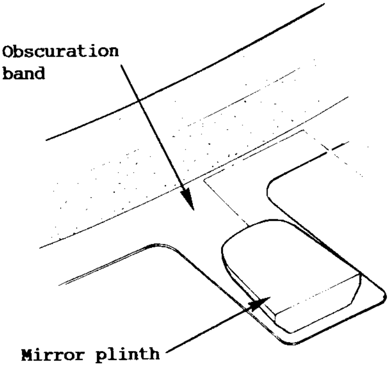
6. Mirror Mounting Plinth:
The interior rear view mirror is secured to a mounting plinth which is itself bonded to the windscreen glass. The plinth is not removeable from the glass, and must be renewed if the windscreen is replaced. The plinth, which is most easily fixed before the screen is fitted, is supplied as part of a kit (A100B6230S) which includes adhesive 'Penloc GZH', and is applied as follows:

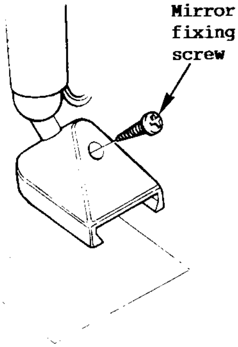
**WARNING:** Contains trichloroethanes and acrylic acid derivatives. Refer to precautions on product packaging.

i) Thoroughly clean bondong face of mirror plinth and corresponding area on inside surface of windscreen using a sharp razor or steel wool.

ii) Bend the PRIMER vial in order to crack the interior flask container. This will allow the primer material to saturate the felt tip. Remove the cardboard cylinder protecting the felt tip and apply primer so as to coat the bonding surface on both plinth and windscreen. Allow five minutes for the primer to dry.

iii) Apply a thin coat of adhesive to the bonding surface of the mirror plinth. Position the plinth on the windscreen with the rounded end towards the top and hold in place for 2 to 3 minutes. Allow at least 10 minutes curing time before fitting the mirror to the plinth.

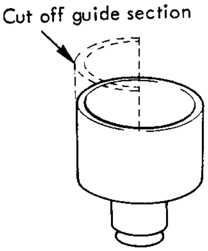


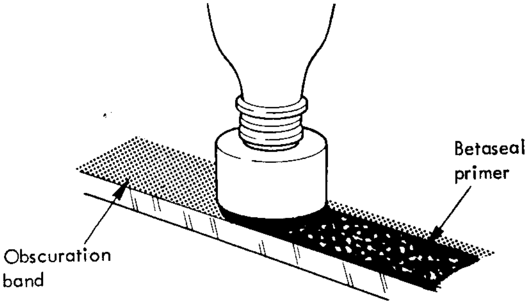


7. If a windscreen pillar or header rail has been replaced or re-fitted, check that the joint gaps between pillar and header rail, or pillar and body have been sealed with Sikaflex adhesive/sealant, and the screen landing joints are filled.

8. Cut the special paper provided in the Betaseal kit into two. With one half, use the wipe cleaner fluid to clean the peripheral edge of the glass, and the whole of the obscuration band on the inside surface of the screen.
Also clean the whole of the bonding area on the body flange, screen pillars and header rail. Clean the underside of the two screen top corner finishers, and the lower half of the outside surface of the screen pillars. With the other half of the paper, wipe dry the areas cleaned.

9. Shake the Betaseal primer container for at least 40 seconds before opening and pouring into the plastic bottle. Cut off the guide portion of the applicator head and fit to the bottle with the sponge pad inserted. Apply a band of primer around the outside edge of the inside surface of the glass, on top of the pre-applied obscuration band; 25mm width (one applicator head) along the base and sides, and 50mm width along the top edge. If the obscuration band has a gap to display a vehicle identification plate which is not used, use masking tape to produce a straight edge, and black out the gap with primer.
Also apply primer:
   - around the peripheral edge of the glass to help prevent moisture ingress;
   - to the underside of the screen top corner finishers;
   - to the lower half of the outside edge of the screen pillars (25mm width);
   - to the outside surface at each top corner, for the corner finishers.

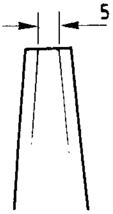




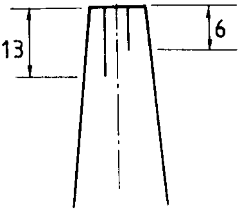
10. When the primer has fully dried (min. 5 minutes, max. 48 hr), fit the finisher to the top edge of the screen, with the lip towards the inside (the finisher channel has pre-applied adhesive), and press firmly into position. Offer up the two side finishers, and trim the bottom ends to the shape of the screen lower edge, but do not fit at this stage.

11. Cut the Betaseal application nozzle to produce the correct bead shape:

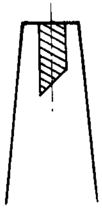
    i) Cut off the end of the nozzle to achieve an inside diameter of 5mm.



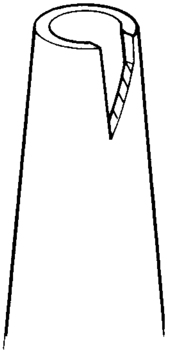
ii) Make two parallel cuts, 5mm apart to depths of 6 and 13 mm as shown.



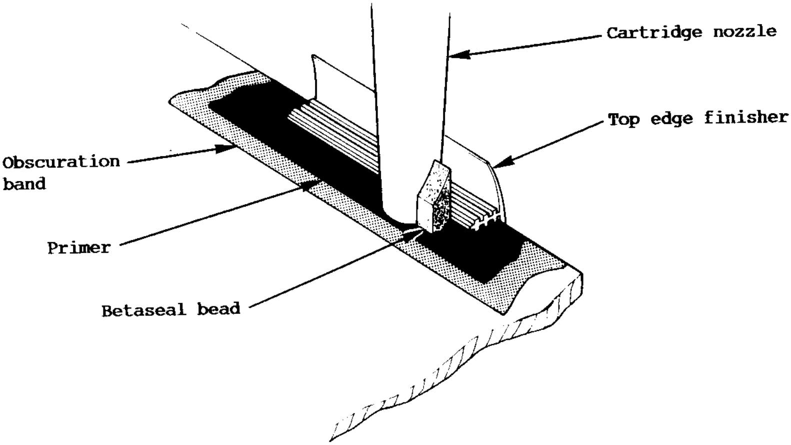
iii) Join the two ends of these cuts and remove the piece of nozzle to form the bead profile.



**Finished nozzle shape**



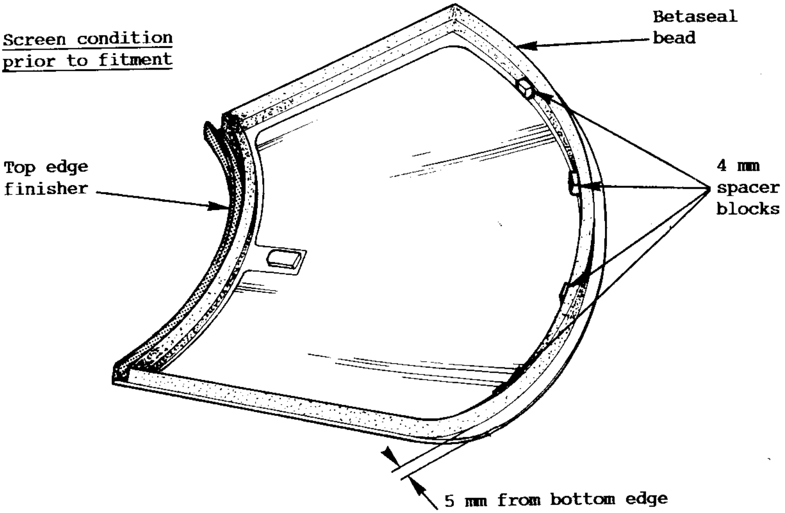
12. Push in the bottom of the Betaseal cartridge and remove the desiccant. Pierce the membrane in the cartridge thread, screw on the application nozzle, and insert in the cartridge gun. Holding the gun vertically, and using a gloved finger as a guide, extrude a continuous bead of Betaseal counterclockwise around the perimeter of the glass.


Cartridge nozzle
Top edge finisher
Obscuration band
Primer
Betaseal bead

The bead should be positioned:
- adjacent to each side edge;
- 5mm up from the bottom edge of the screen;
- adjacent to the edge of the top finisher.

Ensure that the correct orientation of the nozzle is maintained throughout the operation. Manipulate the two ends of the bead to ensure they are completely 'welded' together.

13. Cut the plastic spacer blocks supplied in the Betaseal Kit to make four 4 mm spacers, and insert these, equally spaced, into the inside edge of the Betaseal bead along the lower edge of the glass.



14. Fit the screen onto the body and position so that the screen is centralised, with the edges of the glass aligning as far as is possible with the top and sides of the windscreen frame. Fit plastic or wooden chocks at the base of the screen to support the glass in this position. Fit the two side finishers, pushing them onto the glass edge and into the Betaseal bead. Press gently all round the edge of the glass to ensure adequate joint compression and recheck positioning. Examine the whole length of the joint, and if necessary, use a spatula to paddle extra sealant into any localised area.

15. Wipe off any Betaseal extruded from the joint or from the side finishers, and apply sealant to each top corner of the screen, pushing a little beneath the ends of the edge finishers. Fit the corner finishers, wipe off any extruded Betaseal and tape into position.

16. Extrude a narrow bead of Betaseal along the base of the screen to fill the gap between screen and topshell moulding, from the outboard wiper plinth to the bottom corner of the screen on each side. Use only the minimum amount of sealant necessary, or subsequent removal of the topshell will be impeded.

17. Do not disturb the screen until the Betaseal has fully cured, which will take approximately 4 hours dependent on atmospheric conditions, taking longer in a dry atmosphere.

18. Refit the screen pillar seal carriers and weatherstrips (see below), and water test thoroughly before fitting interior trim.

19. Refit interior trim panels and wiper arms.

Spillage of material

a) Any spillage of Betaseal onto unprimed glass can be readily peeled off after it has cured.

b) Any spillage onto the body can be removed with either Wipe Cleaner No. 4, or white spirit.

Shelf Life

a) Betaseal has a shelf life of over 6 months at ambient temperature in the original unopened package.

b) Betaseal primer has a useful life of only about 24 hrs after it has been exposed to the air, after which it starts to become spongy. If the material is spongy DO NOT USE. Always use glass primer immediately on opening, and replace lid after use.

Contents of Betaseal Kit A075B6158F.

i) One part adhesive sealant Betaseal 71904 in a 300 cc cartridge, standard viscosity.
ii) Cartridge applicator nozzle.
iii) Glass primer applicator bottle.
iv) Glass primer applicator head.
v) Glass primer applicator sponge pad.
vi) Glass primer, black.
vii) Wipe cleaner.
viii) Piano wire 0.6 mm diameter x 120 cm long.
ix) Special cleaning paper.
x) 4 off rubber spacing blocks, approximate 10 x 14 x 20 mm. Cut to size.

## BK.16 - WINDSCREEN PILLAR WEATHERSTRIPS

The seal between the door glass and windscreen pillar takes the form of a moulded skinned foam weatherstrip, mounted in a steel carrier channel itself screwed to the alloy screen pillar.

To Remove

As a polyurethane elastomeric adhesive is used to seal the weatherstrip into its carrier, and to the windscreen frame/body, it is likely to be damaged on removal.

1. Prise out the buttons securing the top and bottom ends of the weatherstrip, and peel from the body, carrier channel and windscreen frame. Clean off the old adhesive.

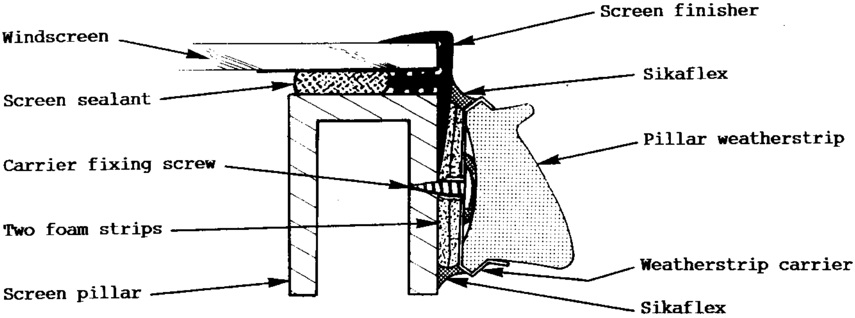
2. If necessary, remove the weatherstrip carrier channel from the screen pillar after releasing the retaining screws. Clean off the old adhesive from the carrier and screen pillar.

To Refit

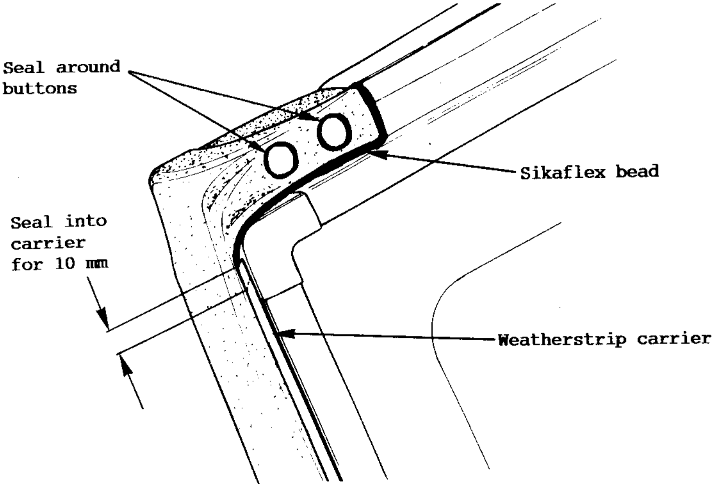
1. Apply two strips of 3mm thick foam, A082U6067F, one on top of the other, to the back of the weatherstrip carrier channel.

2. Fit the carrier to the screen pillar using the screws and washers. Apply a 3mm bead of Sikaflex 221 (A089B6174V) down the inside of the carrier channel, around the top of the pillar to the end of the header rail, and down the 'A' post for the length of the seal.

3. Fit the weatherstrip into the carrier and position so that the top end retaining buttons may be fitted without straining the seal, the bottom end button may be fitted, and the ridge on the weatherstrip starts to taper away at the point where the door mirror plinth seal meets the weatherstrip. Push the base of the weatherstrip beneath the flanges of the carrier, and insert the retaining buttons, pushing fully home.


Screen finisher
Windscreen
Sikaflex
Screen sealant
Pillar weatherstrip
Carrier fixing screw
Two foam strips
Weatherstrip carrier
Screen pillar
Sikaflex

4. Use Sikaflex 221 to seal around the weatherstrip top end, and to seal between the carrier channel and screen pillar along top and bottom sides, as shown in the illustration. Use a spatula to smooth out the sealant for a neat finish.


Seal around buttons
Sikaflex bead
Seal into carrier for 10 mm
Weatherstrip carrier

## BK.17 - WINDSCREEN FRAME

The bottom of each high strength aluminium alloy windscreen pillar, is fixed to the top of each door hinge post using three bolts, two of which use captive nuts in the end of the tubular scuttle beam, with the third bolt using a nyloc nut. The top of each pillar spigots into the hollow section windscreen header rail and is secured by two bolts threaded into the pillar spigot.

### To Remove

1. Remove the front topshell (see section BK.7).

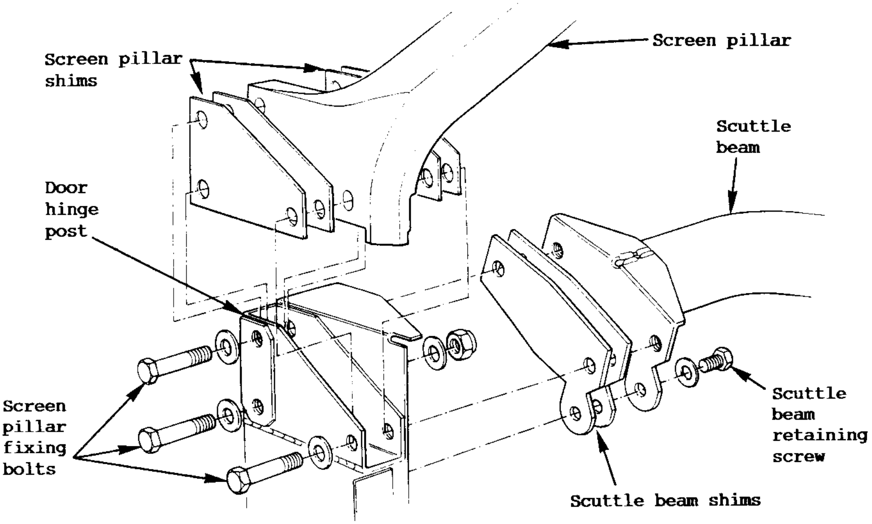
2. Remove the windscreen (see section BK.15)

3. Remove the sun visors, roof latches and trim panel from the windscreen header rail. Remove the trim panel from the windscreen pillar and release the interior lamps harness from the pillar (if applicable).

4. Prise out the buttons securing the top and bottom ends of the moulded rubber screen pillar weatherstrip, and peel from the body, carrier channel and windscreen frame. Remove the weatherstrip carrier from the pillars after releasing the retaining screws.

5. Remove the two bolts securing each end of the header rail to the screen pillar.

6. If fitted, withdraw the roll pin locating the pillar to the outboard side of the door post. Remove the three bolts securing the bottom of each pillar to the door hinge post, noting that the lower front bolt uses a nyloc nut on the inside of the door hinge post. Use a sharp blade to cut the adhesive/sealer around the base of the pillar, and slide the pillar out from the hinge post, if necessary releasing the fascia panel end fixings to provide clearance. Note the position of the shims fitted between the pillar and hinge post.

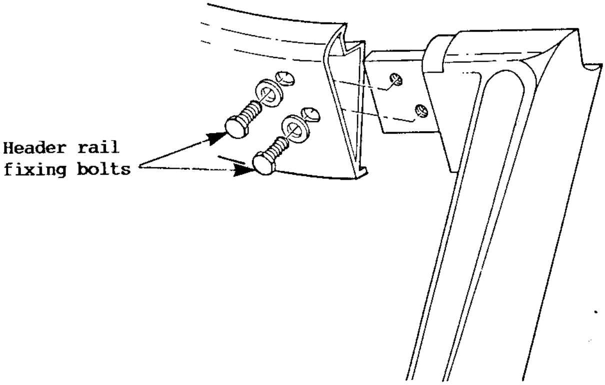


To Refit

1. Clean any old adhesive/sealant from the base of the screen pillar, and from the inside of the top of the door hinge post.

2. Fit one screen pillar into its hinge post, and select sufficient shim plates to take up any side clearance. Distribute the shim plates equally on each side of the pillar and fit the three fixing bolts with thread locking compound applied to the threads of the upper front, and the rear bolts, and plain washers under the heads. Fit the nyloc nut to the lower front fixing bolt, but leave all the fixings finger tight.

3. At the same time as fitting the second pillar, fit the header rail into position, and retain loosely with its two bolts at each end. Shim the second pillar in the same manner as the first.



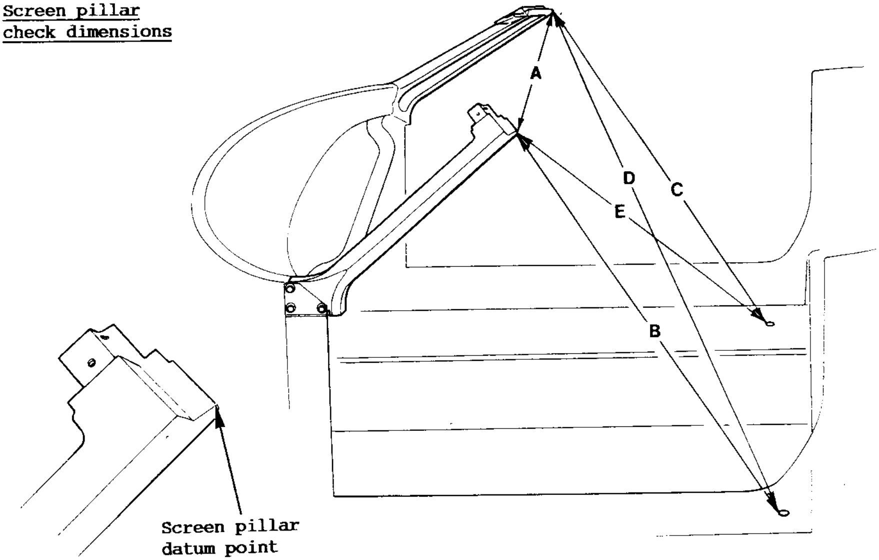
4. Remove both seats, and pull back the carpet to reveal the tooling hole (approx 20mm diameter) in the floor at each side, ahead of the speaker mountings. Remove the grommets.

5. Measure between the top rear corner of each screen pillar and the nearest edge of the tooling holes in the floor as shown in the illustration, and also from one pillar to the other. Compare the figures obtained with the table below, and adjust the position of the pillars if necessary to bring within tolerance. Shims may be transferred from one side of the pillar to the other, and the holes in the pillar allow a certain amount of fore/aft tilt adjustment.

| **Dimension** | **Tolerance** |
|---|---|
| A | 1008 - 1012 mm |
| B | 1092 - 1096 mm |
| C | 1097 - 2001 mm |
| D | 1478 - 1484 mm |
| E | 1478 - 1484 mm |

Tighten the screen pillar bolts and recheck these dimensions.

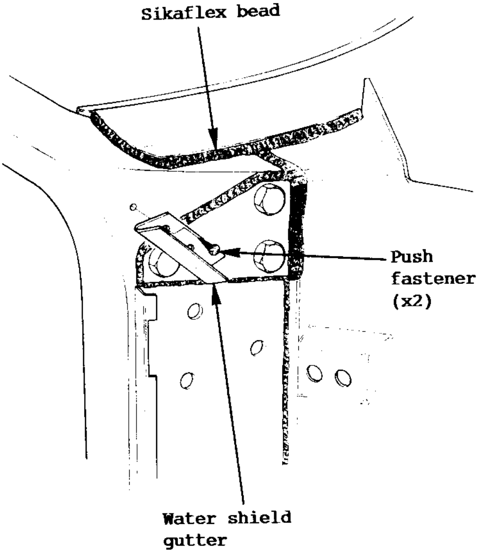
**Screen pillar check dimensions**


A
B
C
D
E
Screen pillar datum point

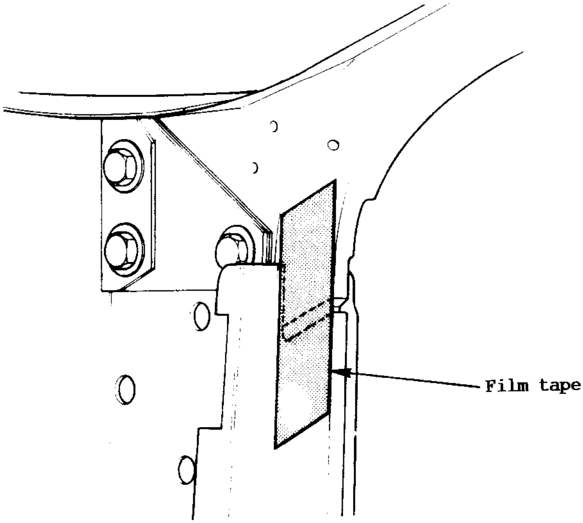
6. Seal the gaps between the screen pillars and front bulkhead using Sikaflex 221 adhesive/sealant (A089B6174V). Ensure that there is a smooth transition along the windscreen landing, between the pillar and scuttle.

7. Use Sikaflex to seal the gaps between each side of the pillar and the door hinge post, and between the top of the pillar and the header rail. Ensure that there is a smooth transition for the header rail weatherstrip, and for the screen landing.

8. Fit the water shield gutter to the bottom of the pillar using the two push-in fasteners.


Sikaflex bead
Push fastener (x2)
Water shield gutter

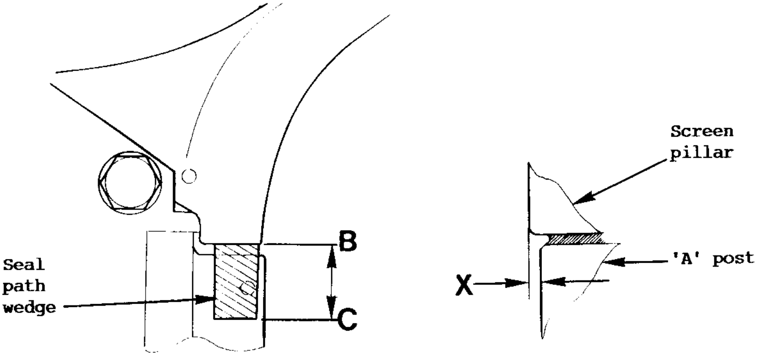
9. Examine the alignment of the door seal path between the bottom of the screen pillar and the body. If the step is less than 1.5mm, check that the joint line is filled flush with Sikaflex, and apply film tape B100U0245F (LH) or B100U0246F (RH) across the joint as shown in the diagram.

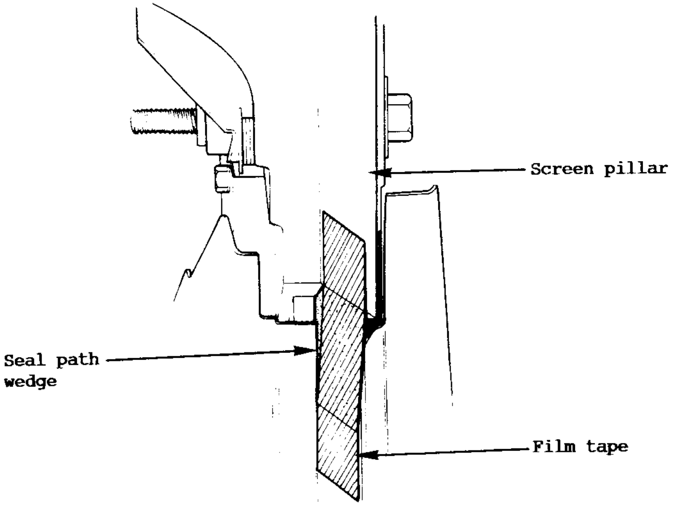


If the step is greater than 1.5mm, fit a seal path wedge A082U6195 to smooth the joint. Check first that the joint line is filled flush with Sikaflex, then cut the wedge according to the chart below.

| | | |
|---|---|---|
| Gap 'X' | 2mm | 3mm |
| Distance 'B' to 'C' | 20mm | 25mm |

Stick the wedge to the body using transfer tape A082U6198V, and seal between the top of the wedge and the screen pillar using Sikaflex. Prime the surface of the wedge with primer A082U6199 before applying film tape as above, but cut narrower to suit the width of the wedge.





10. Refit the windscreen (BK.15), screen pillar weatherstrips (BK.16), front topshell (BK.7), and the remaining parts in reverse order to disassembly.

## BK.18 - BODY REMOVAL PROCEDURE

There are 16 main mounting points securing the body to the chassis, each using a two piece aluminium crimped together and bonded to the body, and an M10 bolt picking up in a caged nut on the chassis. The body may be removed from the chassis using a wheel free type four point lift, leaving the engine in place, by the following procedure:

1. Depressurise the fuel system by tripping the inertia switch (RHD - in battery compartment; LHD - beneath LH rear speaker trim panel) to disable the fuel pump, and starting the engine. After the engine stops from fuel starvation, crank for several seconds to dissipate the remaining fuel pressure.
   Disconnect the battery.
   Disconnect the fuel feed and return pipes at the rear of the engine bay.

2. Remove the front topshell (see section BK.7).

3. Recover or de-pressurise the air conditioning system (see section PE), and disconnect the two evaporator connections at the rear of the engine bay.

4. Drain the cooling system, and disconnect the two heater hose connections at the rear of the engine bay.

5. Disconnect the throttle and clutch cables.

6. Disconnect the brake pipes from the master cylinder, and plug the cylinder ports. Cap the pipe ends.

7. Disconnect the vacuum hose to the brake servo.

8. Disconnect the vacuum hose to the water valve.

9. Disconnect the speedo cable from the transmission.

10. Disconnect the following electrical connections in the engine bay:
- main earth cable and smaller earth lead at RHF of chassis front crossmember, plus starter motor feed cable, and release from the plenum bracket.
- alternator connector block, starter motor solenoid connector, brake fluid level sensor lead, oil pressure gauge sender connector (rear side of block), and on N/A cars, the ignition coil flying lead connector. Release the harness from the chassis.
- ECM earth cable from front end of intake plenum, and release cable from chassis.
- unplug two engine harness connector blocks near the front of the header tank, and on N/A cars the dropping resistor connector, and on Turbo cars the boost vac. solenoid at the rear of the air filter. Unplug the electric water pump harness to main harness connector. Release the harness from the chassis.

11. Remove the struts between the suspension turrets and the 'A' posts.

12. From inside the car, remove the pinch bolt securing the upper steering column u/j, and the bolt securing the upper column assembly to the pedal box. Remove the steering column shrouds and release the fixings securing the top of the column to the scuttle beam, and withdraw the column from the u/j before temporarily refitting the bolts. On USA cars fitted with SIR, see separate publication 'Section WB' for precautions to be taken.

13. Remove the tunnel top trim panel, gear lever knob and gear lever gaiter (see section VD). Remove the carpeted trim panels behind the seats. Unbolt the parking brake lever mounting bracket from the tunnel top.

14. Remove the fascia mask (see section VD), and remove the two bolts securing the scuttle beam brace to the tunnel top.

15. From beneath the rear of the car, release the parking brake cables from the rear calipers, and unclip the cables from the top links.

16. Remove the rear silencer.

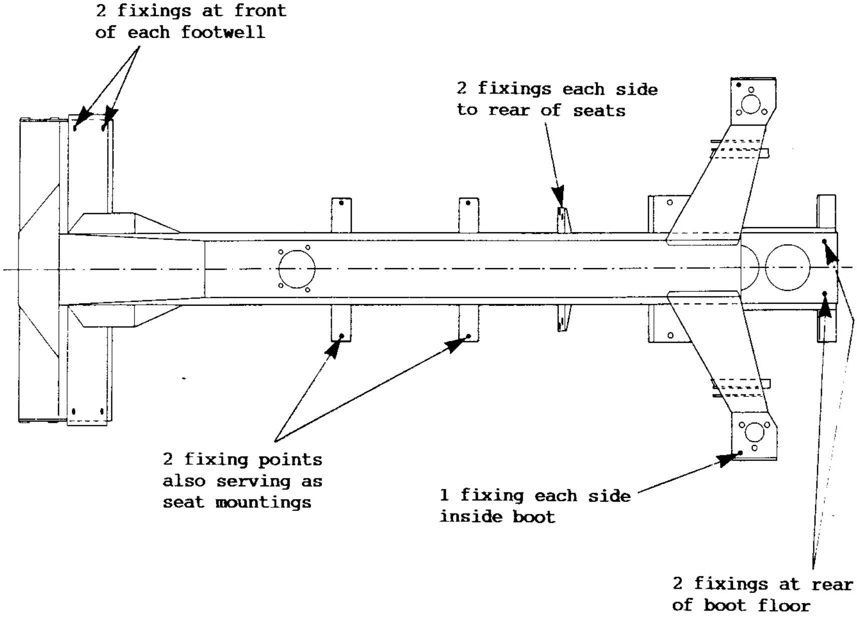
17. Disconnect the battery main earth lead from the front of the RHR chassis leg.

18. Remove the 16 M10 bolts securing the body to the chassis:
- 2 at the front of each footwell, into the back of the chassis front crossmember.
- 2 alongside the bottom of each side of the centre tunnel, also serving as seat mountings, and picking up short outriggers from the side of the chassis centre section.
- 2 in each side on the rear bulkhead, adjacent to the centre tunnel, picking up a bracket at the rear of the chassis backbone.

- 1 at each side of the boot, inboard of the rear wheelarch, into the chassis rear suspension top platform.
- 2 in the spare wheel well, into the chassis rear extension.

19. Position a four point lift beneath the body jacking points, and raise the body clear of the chassis.

## Body/Chassis Fixings


2 fixings at front of each footwell
2 fixings each side to rear of seats
2 fixing points also serving as seat mountings
1 fixing each side inside boot
2 fixings at rear of boot floor

## Preparation Before Body Fitting

Before re-fitting the body, check that the following seals are fitted first:

- Self adhesive foam gasket around the parking brake mounting on the chassis.
- Self adhesive foam gasket around the gear change lever.
- Self adhesive foam gaskets around each rear suspension damper top mount.
- Rubber washers on each of the two spigot bosses for the scuttle brace, at the front of the chassis centre section.

## Body Fitting Procedure

It is important when fitting the body to the chassis, that the following tightening sequence is used, to ensure that the body is correctly positioned, and not unduly preloaded.

1. Lower the body onto the chassis, ensuring that the wiring harnesses or parking brake cables are not trapped between the body and chassis.

2. With the body sat firmly on the chassis mounting points, first fit the two M10 bolts and washers at the front of each footwell into the chassis front crossmember. Torque tighten to 49 Nm (36 lbf.ft).

3. Fit the two bolts and washers at each side of the rear of the centre section, and torque tighten to 49 Nm (36 lbf.ft).

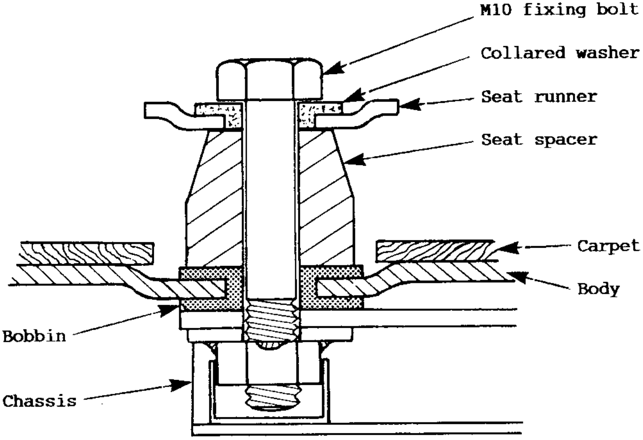
4. Fit the single bolt and washer into the top of each rear suspension turret inside the boot, and torque tighten to 49 Nm (36 lbf.ft).

5. Position the spare wheel bracket in the boot, and fit the two fixing bolts and washers. Torque tighten to 49 Nm (36 lbf.ft).

6. Fit the seat inboard mounting bolts, and torque tighten to 49 Nm (36 lbf.ft).

Continue re-assembly in the reverse order to disassembly.

**Inboard Seat/Body/Chassis Mounting**


M10 fixing bolt
Collared washer
Seat runner
Seat spacer
Carpet
Body
Bobbin
Chassis

## ADDENDUM 1 - WATER INGRESS; Areas of attention

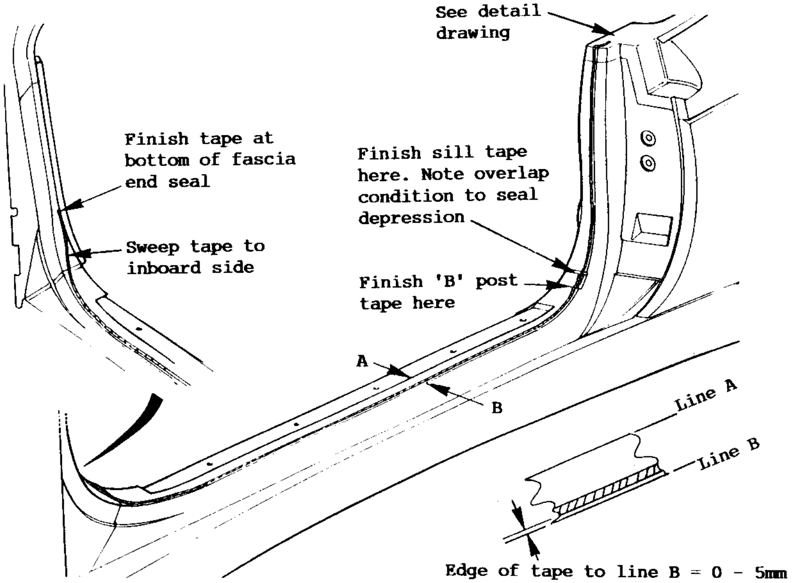
### APPLICATION OF BEAD SEALANT TO DOOR APERTURE

A strip of butyl rubber bead sealant, 4.5 mm dia. is run from beneath the forward end of the roof stowage lid seal, down the 'B' post beneath the outer edge of the trim panel, and along the top of the body sill, beneath the sill tread plate, linking with the fascia end seal. In this way, any water passing the door primary seal, or running down the 'A' or 'B' posts inboard of the primary seal, is diverted towards two drainage nicks in the primary seal on the underside of the door.

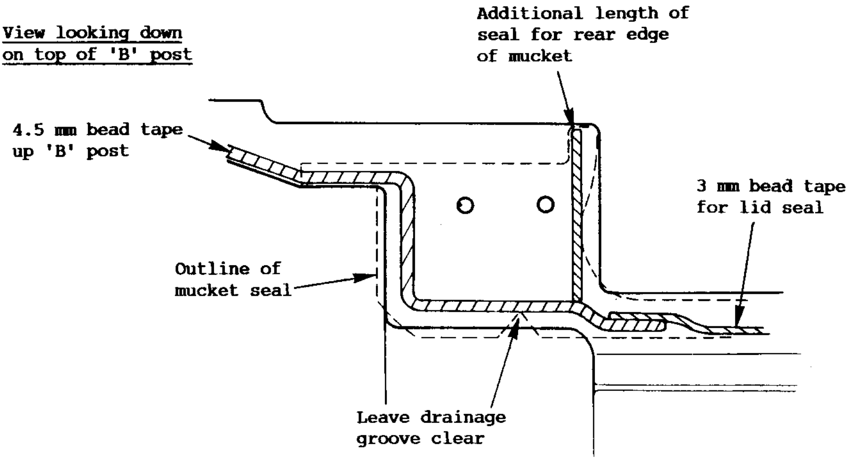
With the 'B' post trim panel and door sill tread plate removed, and the forward end of the roof stowage lid seal released:

1. Apply a 580 mm length of 4.5 mm bead sealant to the body, starting at the end of the lid seal platform and overlapping the lid seal bead. Position the bead as shown in the diagram taking care not to encroach into the drainage 'V' area of the seal. Run the bead down the 'B' post to finish at the lower edge of the depression at the base of the 'B' post.

2. Run a 1140 mm length of 4.5 mm seal from the upper edge of the 'B' post depression along the top outer edge of the body sill, sweeping inwards at the front end to meet the base of the fascia end seal.

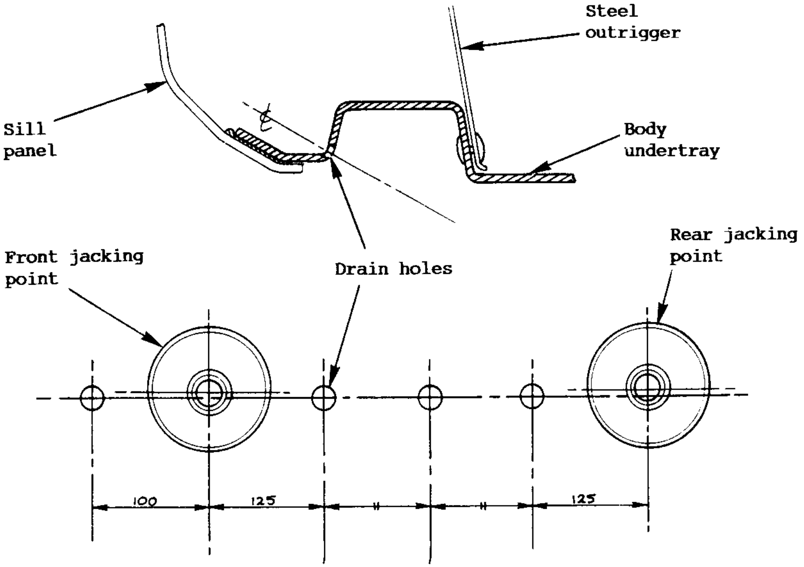

See detail drawing
Finish tape at bottom of fascia end seal
Sweep tape to inboard side
Finish sill tape here. Note overlap condition to seal depression
Finish 'B' post tape here
A
B
Line A
Line B
Edge of tape to line B = 0 - 5mm

**4.5 mm bead A100B6208V**
**3.0 mm bead A100B6207V**


View looking down on top of 'B' post
Additional length of seal for rear edge of mucket
4.5 mm bead tape up 'B' post
3 mm bead tape for lid seal
Outline of mucket seal
Leave drainage groove clear

3. Drill six 8 mm drain holes in the underside of the body sill as shown in the diagram.

4. Carefully cut two notches in the door primary seal on the underside of the door, and seal the cut surfaces by wiping over with Sikaflex.


Steel outrigger
Sill panel
Body undertray
Front jacking point
Drain holes
Rear jacking point
100
125
125

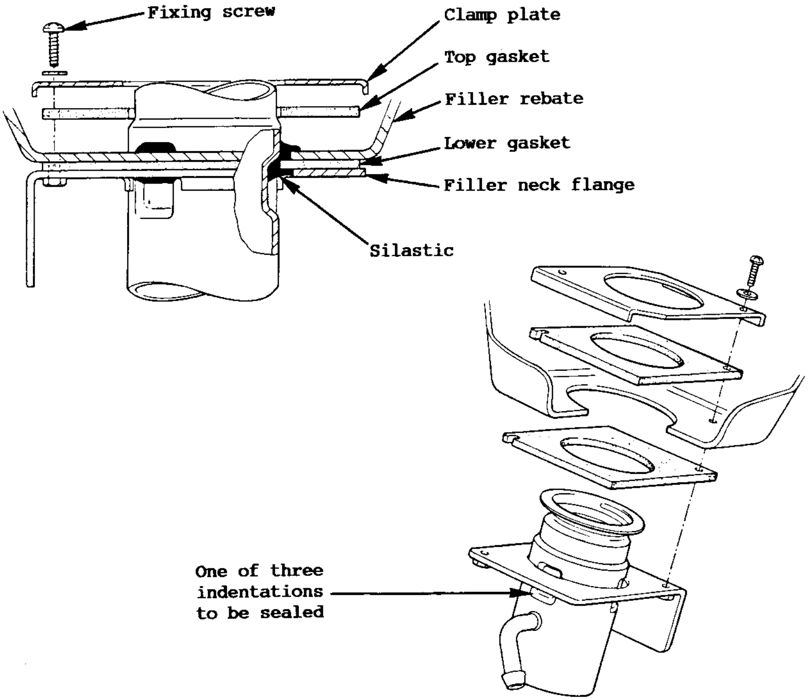
## SEALING OF FUEL FILLER REBATE

There are three aspects of water sealing of the fuel filler rebate: sealing of the filler neck to the rebate; sealing of the rebate to the body; and ensuring that the rebate drain tube is not blocked.

1. Filler neck to rebate: Release the two screws securing the clamp plate, and remove the plate and top gasket. Pull the filler neck up against the underside of the rebate whilst sealing between the neck and rebate with black Silastic. Push the sealant down into the gap, paying particular attention to the three indentations around the neck. Also apply a spot of sealant into each of the two fixing holes before refitting the top gasket and clamp plate and tightening the two screws.

2. Rebate to body: Check the integrity of the joint between filler rebate and the body by using a thin tie wrap or similar to poke around the joint line and search for any gaps in the adhesive. If any gaps are found,- or if water ingress from this area is established, use a spatula to squeeze Sikaflex into the area concerned, taking care to leave a neat appearance.

3. Rebate drain tube: The purpose of the filler rebate drain tube is to drain any spilled fuel or rain water from the rebate onto the ground beneath the vehicle. Check that the tube is not blocked by blowing through with an airline.



## DOOR SEALING

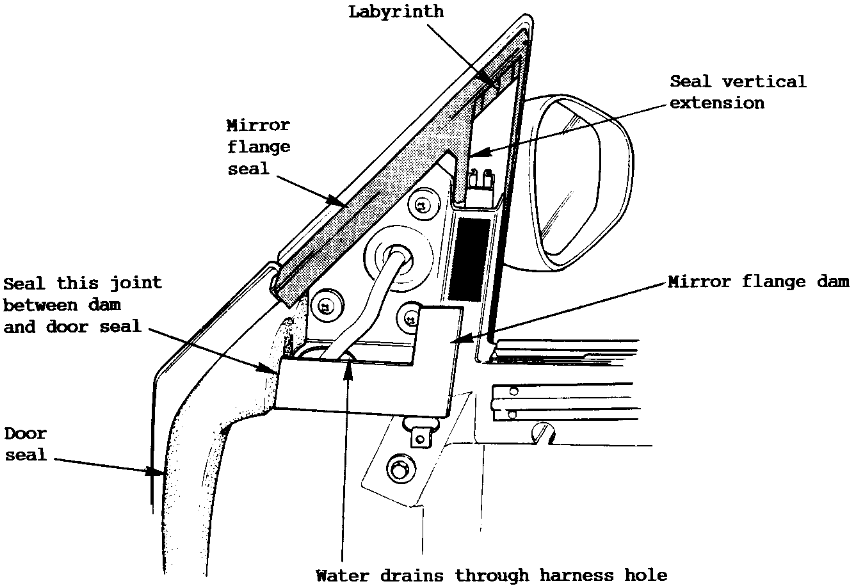
Areas to be considered include the mirror flange seal and dam, adjustment of the door glass inward tilt, and sealing of the fixings and panels attached to the inner door panel. The door shell is provided with drain holes in its underside in order to drain away any water collecting in the bottom of the door, but to prevent water ingress to the interior, the inner panel of the door shell must be sealed:

1. Mirror flange seal: Check that the mirror flange seal includes a vertical extension to contact the front edge of the glass, and a labyrinth seal at the apex. If necessary, renew the seal to fit the latest specification.

2. Mirror flange dam: In order to divert any water in the mirror flange area into the inside of the door shell via the mirror harness hole (no grommet), a dam is glued (Silastic) along the inside edge of the door shell between the front slider channel and the top of the door primary seal.

3. Adjustment of door glass inward tilt: See Service Notes section BK.3.

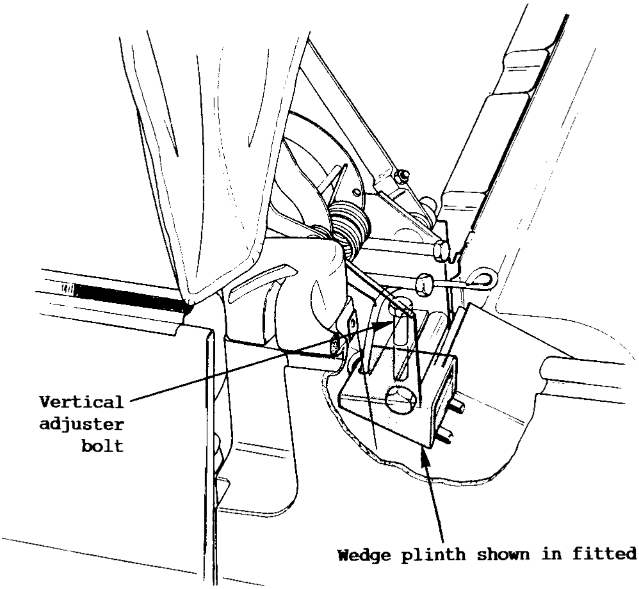
4. Sealing of fixings and panels: Check that there are rubber gaskets fitted between the window lift channel lower mounting bracket and door shell, and between the rear guide channel lower fixing bracket (or shim plate) and door shell. After adjustment of the door glass has been completed, seal around all screw heads on the inner door panel with Silastic. Similarly seal all spire clip holes, wiring clips, grommets etc. Check that the speaker is protected by polythene sheet sandwiched between the mounting panel foam seals. Seal all door access panels with Silastic.

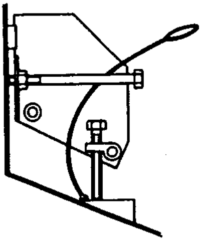


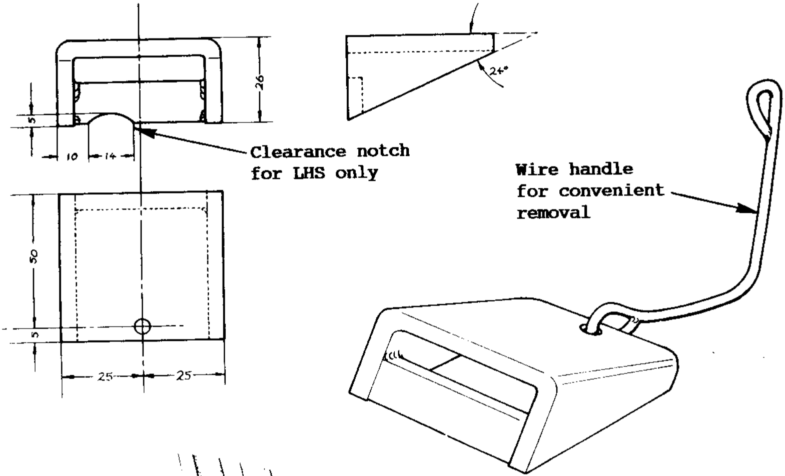
ROOF SEALS

It is essential that the owner understands the importance of lowering the door windows before erecting or lowering the soft top roof. Otherwise damage to the roof seals may be caused. In the interests of optimum sealing and freedom from wind noise, the owner should also be advised to manually align the joints in the roof cant rail seals at each side, after erecting the roof.

The only adjustments that may be made to the soft top roof assembly, are the fitting position of the roof mechanism in the 'B' posts, and the position of the latch plates on the windscreen header rail. The roof mechanisn itself is adjusted and set at the manufacturers, and it is **essential that no attempt is made** to re-adjust the settings or linkage. Any such attempt will render the roof warranty void. The mounting position of the roof should be set using the procedure detailed in Service Notes section BK.13, but the use of a pair of locally made wedge plinths will enable the roof height setting to be achieved more easily. These wedges are positioned against the tabs on the seat belt reinforcing struts, and form a horizontal platform against which the height adjuster bolts can bear. These wedges should be fabricated locally from any sufficiently hard material e.g. steel, aluminium, plastic, wood.

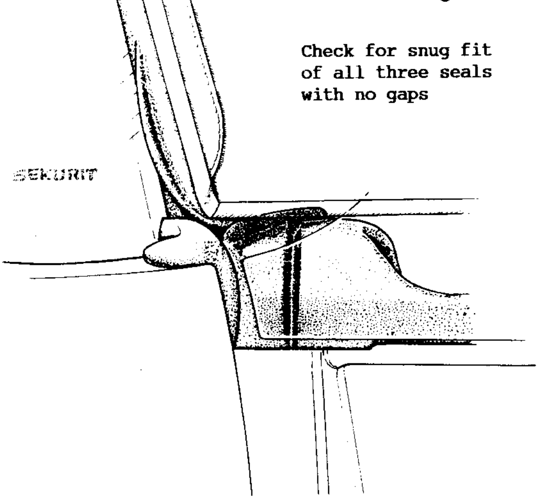

**Vertical adjuster bolt**
**Wedge plinth shown in fitted position**





Clearance notch for LHS only

Wire handle for convenient removal



Check for snug fit of all three seals with no gaps

After adjusting the roof mechanism for optimum fit at the base of the falling pillar seal, it may be necessary to adjust the header seal carrier fore/aft position to optimise sealing at the header rail. Remove the soft top header trim panel for access to the two screws at each side which secure the header seal carrier to the roof. Slacken these screws, and move the seal carrier to achieve a good fit of the header seal along the whole length of the screen header rail. Tighten the screws and refit the trim panel.

Each of the roof seals i.e. header rail, intermediate (cant rail), falling pillar ('B' post), and rear deck, are available as service replacement kits.

## Falling Pillar Seal Replacement

With the hood at position 2 (fig.1) locate the screws that secure the falling pillar seal/carrier. A cut out should be visible along the forward edge of the carrier, the seal should be prized out of the abutment channel at this point to reveal screw.

The seal will also be secured to the hood,at the top, by means of adhesive, and at the bottom by a button fastener. A scraper or knife should be used to separate top of seal from hood frame.

Clean all traces of seal and adhesive from top of pillar, touching up any areas where paint has been chipped.

## Parts Required

| Component | Part No. |
|---|---|
| LH Falling Pillar Seal Kit..... | A100B6167S |
| RH Falling Pillar Seal Kit..... | A100B6190S |
| Betaseal Adhesive Kit.......... | A075B6158J |
| Loctite 380 (Superglue) | |

Each seal kit comprises;

- 1 of Seal, falling pillar
- 1 of Carrier, seal
- 2 of Screw, M5x10 pan head
- 1 of Button fastener

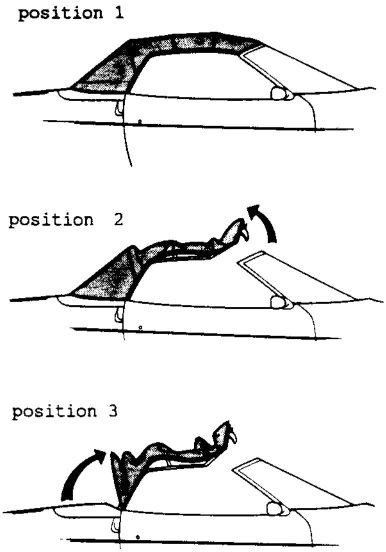
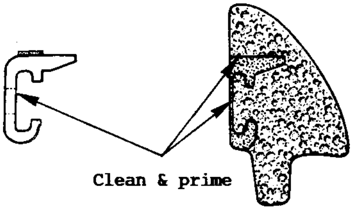


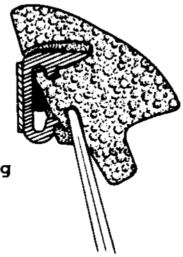
Figure 1

## Operation

Using a brush and 'Betaclean 3900' or 'wipe clean' from Betaseal kit, clean seal abutment face of carrier and retaining faces of the falling pillar seal. Allow a minimum of 5 minutes 'flash off' period, after which these same areas should be primed using 'Betaprime 5402' or primer from Betaseal kit, this time allowing a minimum of 5 minutes, and a maximum of 72 hours 'flash off' period. Should this period be exceeded re-apply primer.

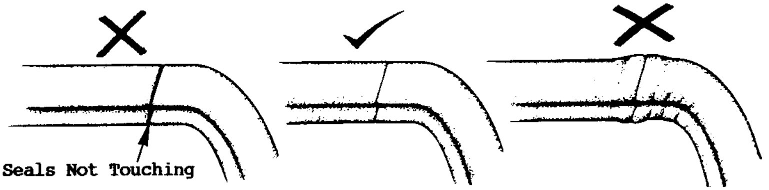
### Seal/Carrier Preparation



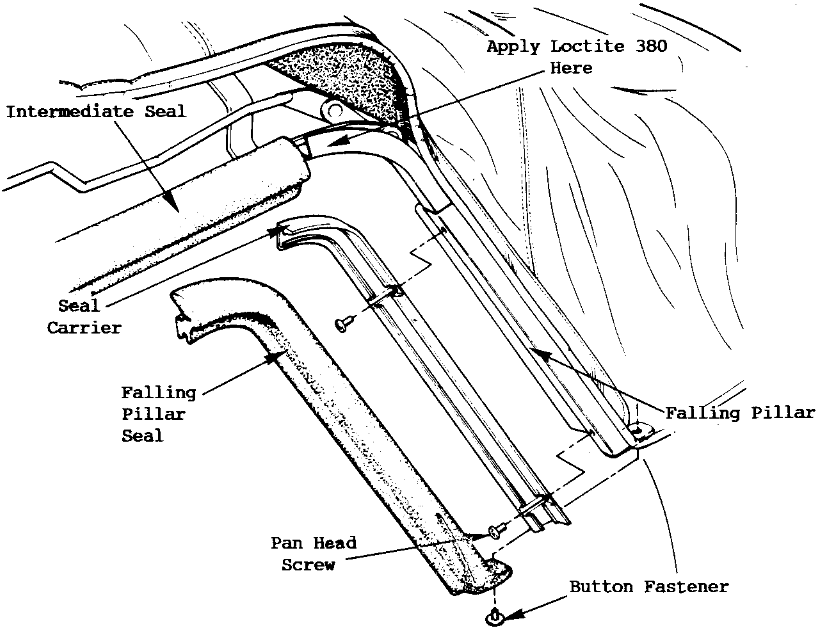


Fit carrier to hood frame/pillar using screws provided. Thread lock should be used on the screws which must be torqued to 7-8Nm. Assemble seal to carrier feeding top/rear edge of seal abutment face into the channel first, using a blunt edged spatula, ease lower/front edge into place.

Erect hood to position 1(fig 1). The seal can now be adjusted to give the correct alignment with intermediate seal to ensure a weatherproof joint is produced. Using thumb/finger pressure only the seal may be eased towards or away from the adjacent seal to comply with the illustration below.


✗
✓
✗
Seals Not Touching

Lift hood to position 3 (fig 1) and fit button fastener to the lower edge of the seal to securing it to the hood at the base of the falling pillar.


Apply Loctite 380 Here
Intermediate Seal
Seal Carrier
Falling Pillar Seal
Falling Pillar
Pan Head Screw
Button Fastener

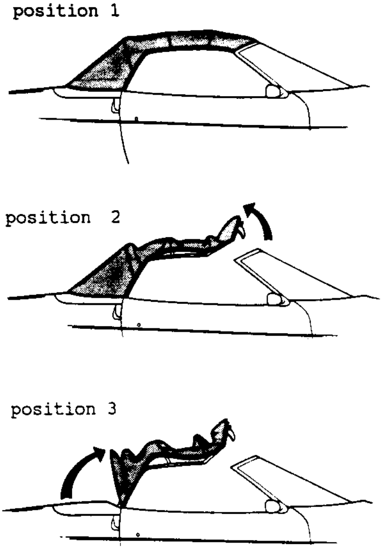
Move hood to position 2 (fig 1), using 'Loctite 380' glue top edge of seal to the hood frame/pillar, ensuring its position relative to the intermediate seal remains unchanged. Leave for ? minutes to allow adhesive to cure.

Seal should now be peeled out of abutment channel, care must be taken not to damage its 'skin'. With the seal out apply a 5mm bead of 'Betaseal 71904' along the carrier abutment channel. The seal can now be fed back into the carrier as before.

Erect hood to position 1 (fig 1) and leave it in that position for no less than 48 hours, this will ensure adhesive is fully cured.

## Intermediate Seal Replacement

With the hood at position 2 (fig.1) locate and remove the two screws retaining the intermediate seal carrier, ensure the associated nuts located between the seal and seal carrier are retained. Lift away the seal and spacer from cantrail.



## Parts Required

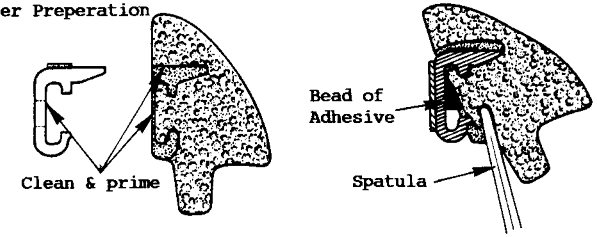
| Component | Part No. |
|---|---|
| LH Intermediate Seal Kit........ | A100B6189S |
| RH Intermediate Seal Kit........ | A100B6190S |
| Betaseal Adhesive Kit........... | A075B6158J |
| Loctite 380 (Superglue) | |

Each seal kit comprises;
-1 of Seal, intermediate
-1 of Carrier, seal
-2 of Screw, M5x12, CSK
-2 of Washer, star, CSK
-1 of Plastic spacer
-1 of Adhesive strip

## Operation

Using a brush and 'Betaclean 3900' or 'wipe clean' from Betaseal kit, clean seal abutment face of carrier and the retaining faces of the intermediate seal. Allow a minimum of 5 minutes 'flash off' period, after which these same areas should be primed using 'Betaprime 5402' or primer from Betaseal kit, this time allow a minimum of 5 minutes, maximum of 72 hours 'flash off' period. Should this period be exceeded re-apply primer.

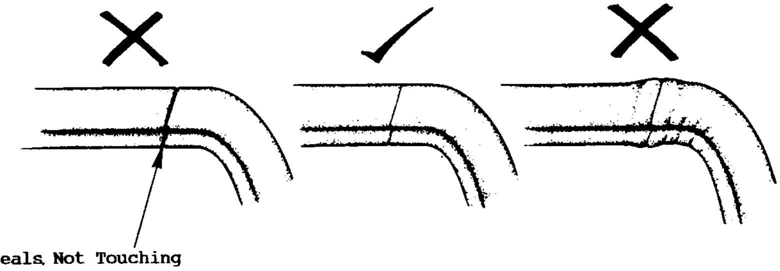
**Seal/Carrier Preperation**



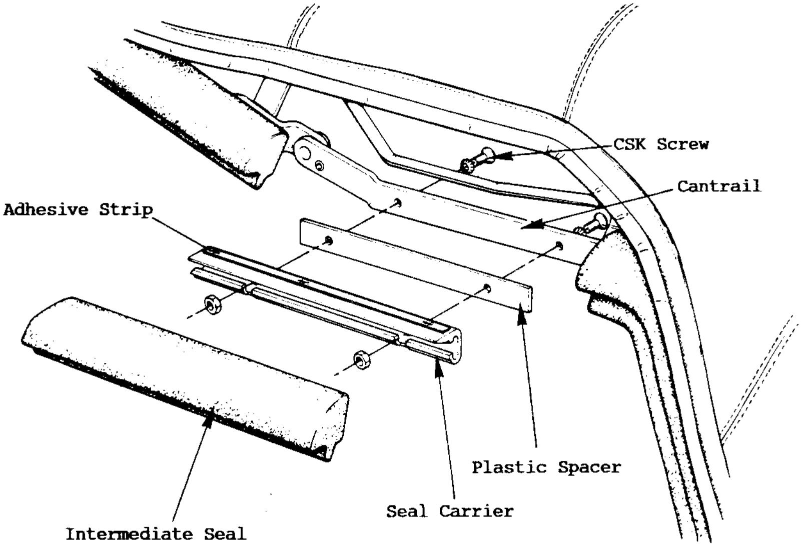
Peal backing off one side of adhesive strip and stick it to the top of the seal carrier (see illustration above). Fit carrier to hood cantrail using screws and nuts provided ensuring plastic spacer is positioned between them. Thread lock should be used on screw threads and screws should be torqued to 7-8Nm.

Fit seal to carrier by feeding the top edge of the seal abutment face into the abutment channel first, the lower edge can then be eased into position using a blunt, round edged spatula.

With the seal in place erect hood to position 1 (fig.1). The seal can now be adjusted to give the correct alignment with the header seal at the front, and the falling pillar seal at the rear. To ensure a weatherproof joint is produced move the seal to comply with the following illustration, using thumb/finger pressure only.


Seals Not Touching

Move the hood to position 2 when an acceptable fit is acheived. Lift the top edge at each end of the seal and using Loctite 380 glue into position, ensuring its relative position to the other seals remains unaltered. Allow adhesive to cure.


CSK Screw
Cantrail
Adhesive Strip
Plastic Spacer
Seal Carrier
Intermediate Seal

Ease seal out of abutment channel, taking care not to tear seal skin particularly at the points just glued. Apply a 5mm Dia bead of 'Betaseal 71904' to the abutment channel and refit seal as before. The backing of the adhesive strip can now be removed.

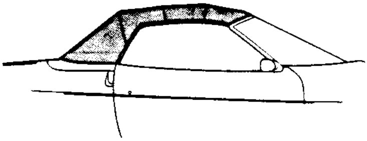
Erect hood to position 1 (fig.1) and leave it in that position for no less than 48 hours allowing adhesive to fully cure.

## Header Seal Replacement

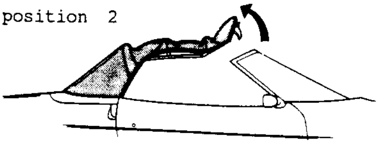
With the hood at position 2 (fig 1) locate and remove 4 screws securing seal carriers to cantrail, ensure the associated nuts located between the seal and the seal carrier are retained. Lift away LH & RH seal carrier and spacer.

Peal header seal out of the channel at the front of the hood, clean any traces of adhesive or seal left behind taking care not to damage, happich.

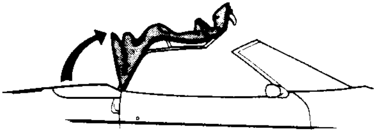
position 1



position 2



position 3



## Parts Required

| Component | Part No. |
|---|---|
| Header Seal Kit............. | A100B6165S |
| Betaseal Adhesive Kit....... | A075B6158J |
| Loctite 380 (Superglue) | |

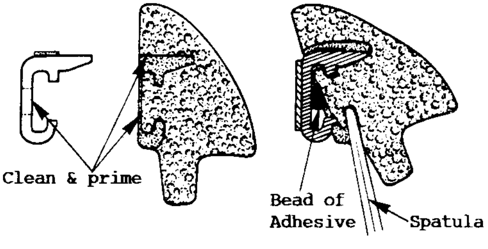
Each seal kit comprises;

- 1 of Seal, hood header
- 1 of Carrier, seal LH
- 1 of Carrier, seal RH
- 4 of M5x12 CSK screw
- 4 of M5 star washer CSK
- 2 of Plastic spacers
- 2 of Adhesive strip

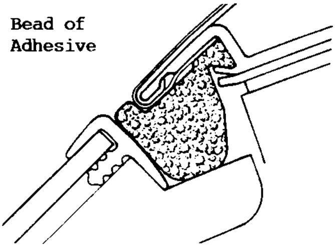
## Operation

Using a brush and 'Betaclean 3900' or 'wipe clean' from Betaseal kit, clean seal abutment faces of LH and RH seal carriers, header rail (including happich) and all along retaining faces of seal. Allow a minimum of 5 minutes 'flash off' period.

**Seal/Carrier Preparation**



**Header Seal in Position**

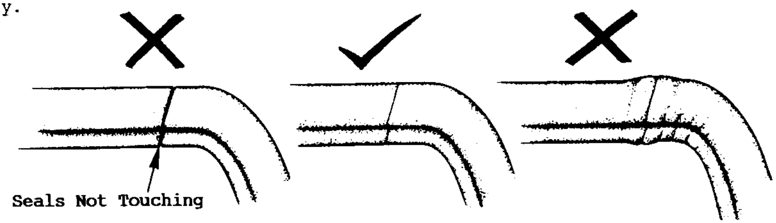


Using a brush and 'Betaprime 5402' or primer from Betaseal kit, prime header seal abutment faces of LH and RH carriers, header seal channel and retaining surfaces of header seal. Allow a minimum of 5 minutes, maximum of 72 hours 'flash off' period. Should this period be exceeded re-apply primer.

Peal backing off one side of adhesive strip and fit to LH and RH seal carrier and position as shown.

Fit LH and RH carriers to front of cantrail using fixings supplied. Thread lock should be used on screws which should be tightened to 7-8Nm. Fit one end of the header seal to each of the two carriers by feeding the top edge of the seal abutment face into the abutment channel, the lower edge can then be eased into position using a blunt, round edged spatula.

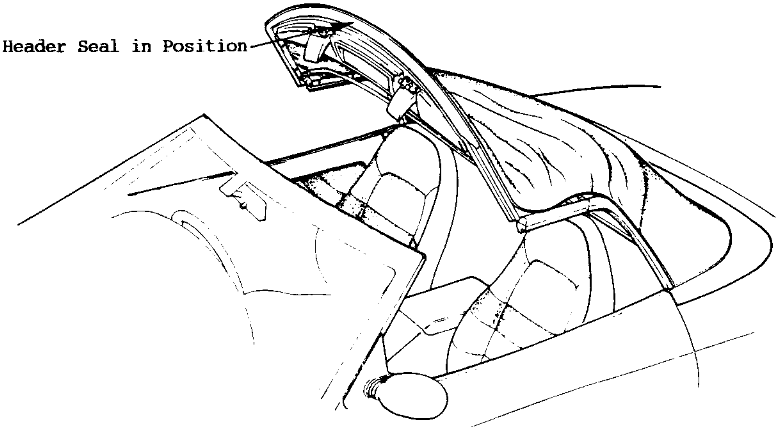
With the seal in place move hood to position 1 (fig 1). The seal can now be adjusted to give the correct alignment with the intermediate seal. To ensure a weatherproof joint is attained adjust the seal to comply with the illustration below. Adjustment is made by easing the seal along using thumb/finger pressure only.



When an acceptable joint has been produced move hood to position 2 (fig 1). Using loctite 380, glue rear edges of seal to top of LH and RH carrier, taking care not to change seals relative position to the intermediate seal. Check this by moving hood to position 1 (fig 1) while adhesive cures.

Move hood to position 2 and ease seal out of carrier abutment channel. Care must be taken not to tear seal at the point just glued. Using 'Betaseal 71904' adhesive apply a continuous bead, 5mm in dia, across header seal retaining channel from the LH to RH seal carrier and along the seal abutment channel of each carrier.

Ease seal back into LH and RH carriers and fit header seal by working from each corner towards the hood centre line. Ensure seal recesses align at header catch areas, adjust where necessary.

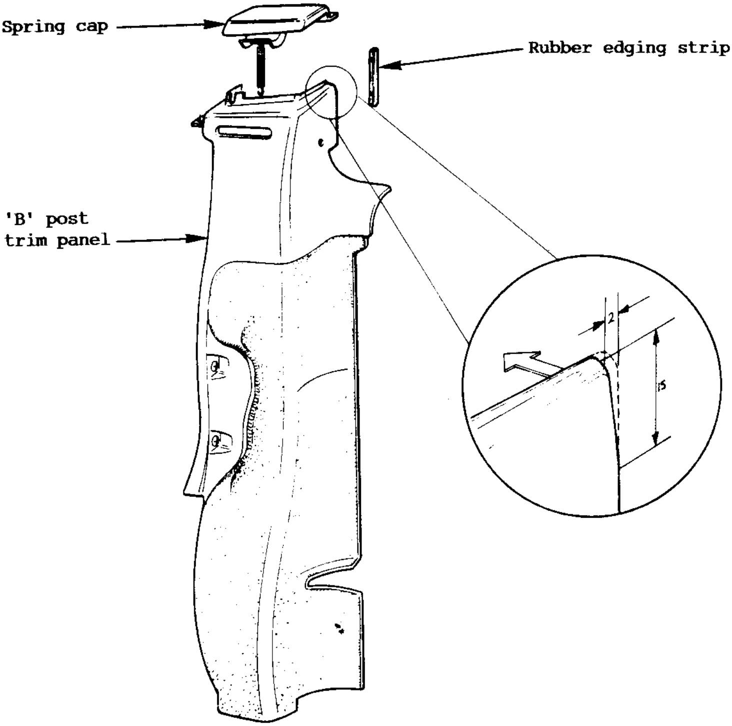


Apply 'Betaseal 71904' adhesive to header seal/happich face contact area at LH and RH front corner positions. Peal backing of adhesive strip on seal carrier.

Move hood to position 1 and lock catches to hold header seal in position. Clean any excess adhesive from front corners of hood using 'Betaclean 3900'. Carry out a visual inspection for correct alignment of corner mouldings, adjust where necessary with hood unlocked. Leave hood locked for a minimum of 48 hours to allow adhesives to fully cure.

Modification of 'B' post trim panel: In order to avoid the possibility of the roof seals being damaged when stowed by the top rear edge of the 'B' post trim panel, it is recommended to carry out the following modification to the trim panel:

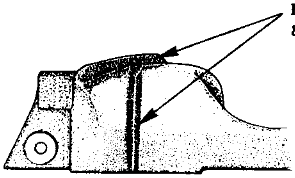
1. Remove the rubber edge finisher, and cut 2 mm off the rear edge of the trim panel, tapering off to a point 15 mm down.
2. Gently heat the trim panel rear edge with a heat gun, and bend outboard sufficiently to avoid contact with the roof seals when stowed, and enable the 'B' post sprung cap to fit correctly over the top of the panel (with edging strip fitted)
3. Refit or renew the rubber edge finisher, positioning flush with the top edge of the panel.

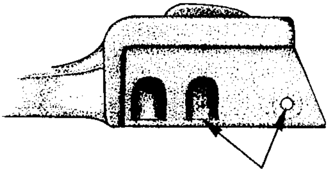


ROOF STOWAGE LID SEAL

The roof stowage lid seal has a moulded lump at each end which is known as the 'mucket' seal, and is designed to fill the space between the roof mechanism or stowage lid and the body. The shape of the mucket seal should be checked with the diagrams to ensure that the latest version is fitted.

**Identification of latest version of mucket seal**

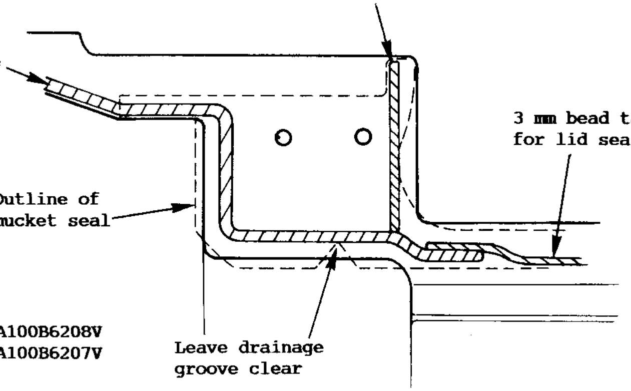

Note ridge & groove


Check that reinforcement is provided at fixing points

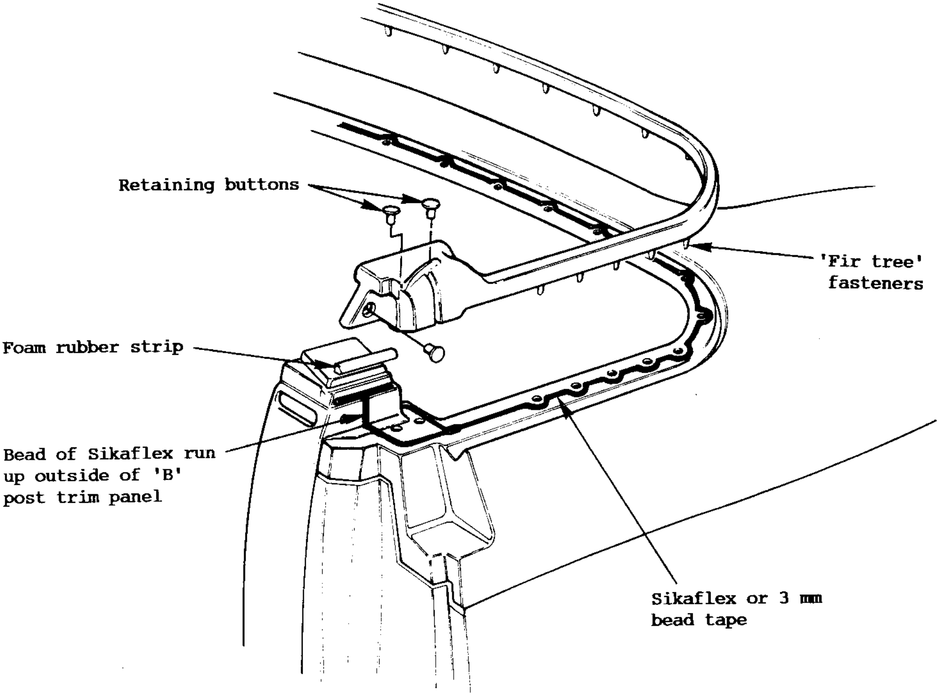
Fitment of the roof stowage lid seal is detailed in Service Notes section BK.12, but also note the following points:

1. Do not fix the ends of the seal until the 'B' post trim panel is fitted.

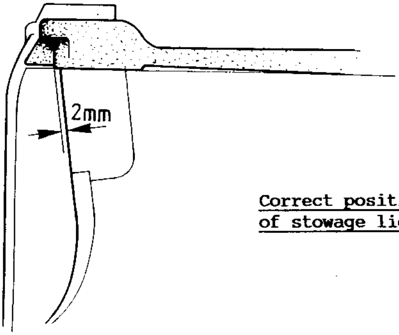
2. Do not fit the butyl tape at the ends of the seal as detailed in BK.12, but apply the bead sealant strip to the end of the roof lid seal platform as detailed in the diagram.


Additional length of seal for rear edge of mucket
4.5 mm bead tape up 'B' post
3 mm bead tape for lid seal
Outline of mucket seal
Leave drainage groove clear

4.5 mm bead A100B6208V
3.0 mm bead A100B6207V

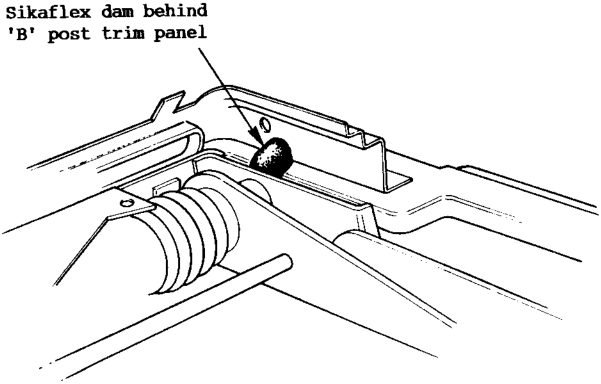

Retaining buttons
'Fir tree' fasteners
Foam rubber strip
Bead of Sikaflex run up outside of 'B' post trim panel
Sikaflex or 3 mm bead tape

3. Ensure that the ends of the seal are positioned as shown in the diagram before fitting the push-in retaining buttons (3 off at each end) and taping in position while the sealant/adhesive cures.



Correct positioning of stowage lid seal

4. Use Sikaflex to create a dam behind the 'B' post trim panel and divert any water on the inboard side of the seal away from the cabin.


**Sikaflex dam behind**
**'B' post trim panel**

## VENTILATION DUCT CONNECTOR

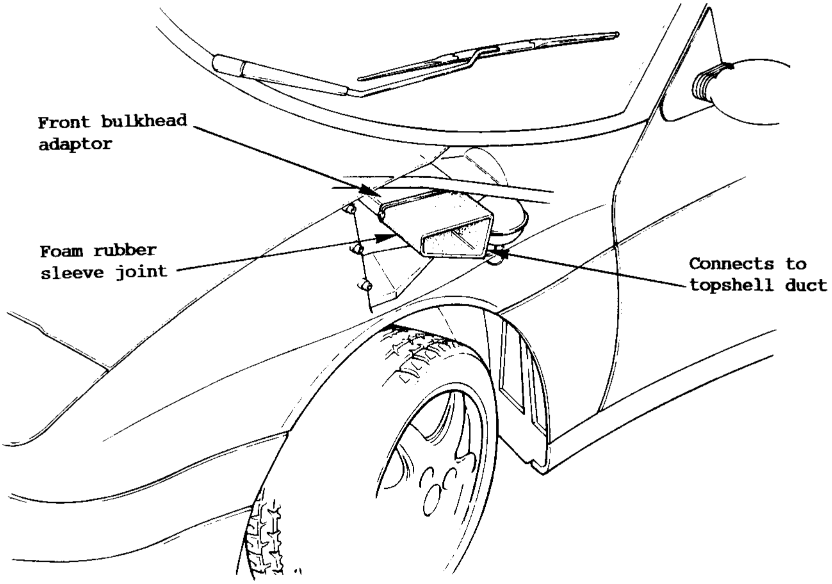
The ventilation duct incorporated into the underside of the front topshell, connects with a duct adaptor on the front bulkhead via a foam rubber sleeve joint located at the top rear of the passenger side front wheelarch.

1. For access to the joint, remove the wheelarch liner.

2. The sleeve joint is made from skinned foam rubber, which is waterproof provided the exterior skin remains intact. If the skin is broken, the foam will absorb water which can be drawn into the vehicle interior via the heater/air conditioning system. Check the sleeve for water absorption and replace if necessary.

3. Check the security of the sleeve which is retained at each end by a long tie wrap which should be tightened securely. In order to provide the sleeve with a grippier mating surface, the spigot on both the bulkhead adaptor and topshell duct is wrapped with a length of self adhesive foam tape:
   Bulkhead spigot tape (4.5 mm) - A082U6068V
   Topshell spigot tape (3 mm) - A082U6067F

4. Also check the joint between bulkhead adaptor and bulkhead, and if necessary seal with Sikaflex.

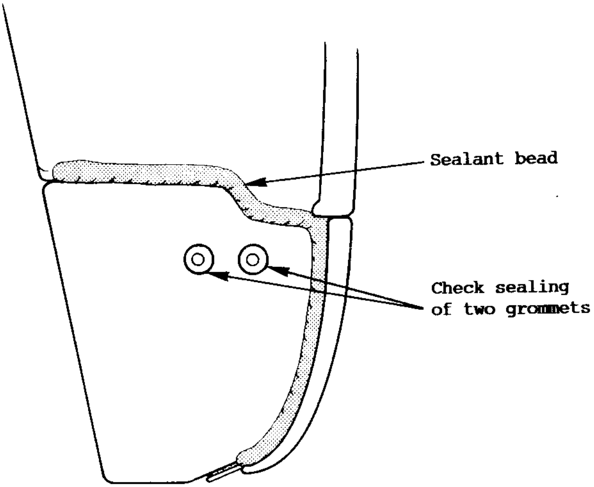


## BODY JOINT SEALING

When checking the body joints for sealing, pay particular attention to the area at the front of the rear wheelarchs. Remove the two side trim panels from the hood stowage area and use a torch to check for water ingress when applying a hose pipe to the outside of the vehicle.

1. Check the front end of the joint line between rear topshell and rear quarter panel, and reseal if necessary using Sikaflex.
2. Check the two sealing grommets inside the bottom front edge of the rear wheelarch, and the joint between rear quarter panel and sill inside the wheelarch. Also check around the lip of the rear wheelarch.

**Forward view inside RHR wheelarch**



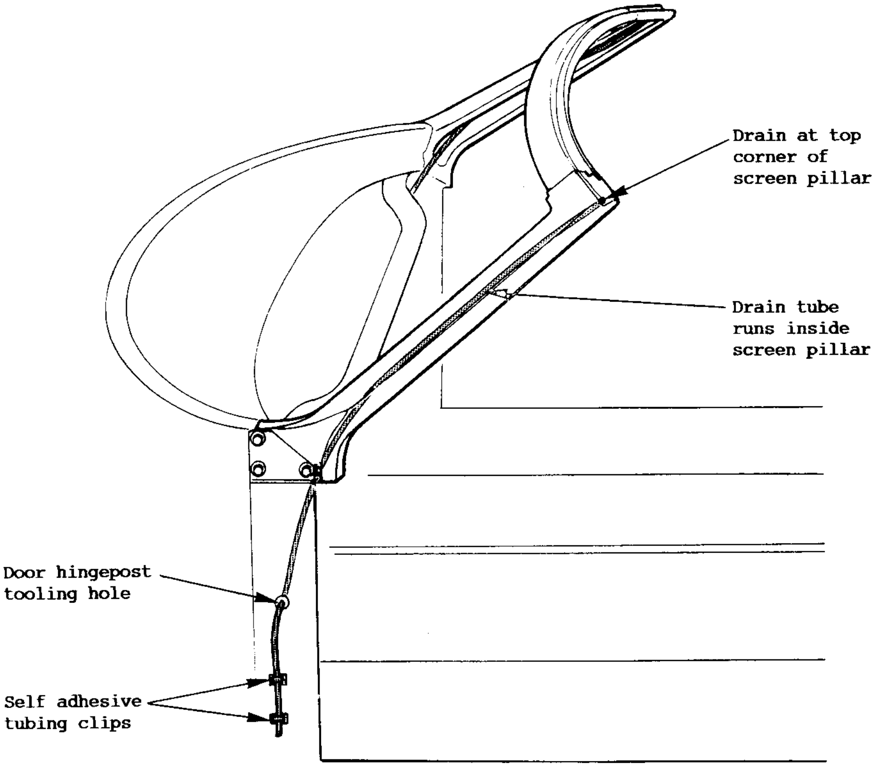
3. In order to reduce the quantity of water shed by the windscreen wipers into the door hinge post area, it is recommended to seal both outer rear edges of the front topshell to the base of the screen using Sikaflex. Use only sufficient sealant to complete the bead, or subsequent topshell removal will be impeded.

## BOOT GROMMET

A grommet is provided at each side of the boot to provide access to the rear suspension top link inboard pivot bolt. Check that this grommet is securely sealed using Silastic.

HEADER RAIL DRAIN TUBE

Later cars have a drain pipe fitted at each end of the windscreen header rail. This takes the form of a short pipe glued through the top corner of the screen pillar, which serves to drain any water collecting in the space between the roof header seal and the header rail. Plastic tubing leads from the underside of this pipe down the inside of the screen pillar, and out though the door hinge post tooling hole.


Drain at top corner of screen pillar
Drain tube runs inside screen pillar
Door hingepost tooling hole
Self adhesive tubing clips

## ADDENDUM 2 - REPLACEMENT OF FOLD BACK HEADLAMPS BY SINGLE PIVOT TYPE

If for any reason the early type 'fold back' headlamp system is to be replaced by the later type 'single pivot' system (see sub-section BK.14), the following procedure should be adopted:

Parts Required

| **Description** | **Part Number** | **Qty** |
|---|---|---|
| Headlamp Pod, RH | A100B1160S | 1 |
| Headlamp Pod, LH | A100B1161S | 1 |
| Headlamp Carrier Ring, outboard (plastic) | B100M0107F | 2 |
| Headlamp Mounting Ring, Main, LH (steel) | A100M0247F | 1 |
| Headlamp Mounting Ring, Main, RH | A100M0248F | 1 |
| Headlamp Mounting Ring, Dip, LH | A100M0249F | 1 |
| Headlamp Mounting Ring, Dip, RH | A100M0250F | 1 |
| Adjuster Screw, headlamp, No.8 x 50 | A100W5176F | 12 |
| Spring, headlamp adjuster screw | A100B6159F | 12 |
| Screw, M4 x 20, h/l assy to pod | A100W5173F | 12 |
| Setscrew, M6 x 25, link to pod (2),<br>relay lever pivot (4) | A075W1031Z | 6 |
| Setscrew, M6 x 20, relay lever bracket fix | A075W1030Z | 4 |
| Spacer, 4.0 mm, link to pod (2),<br>pod link/relay lever (4) | A100B1060F | 6 |
| Spacer, 1.5 mm, pod link/pod nut (2)<br>motor link/relay lever nut (2)<br>motor link/rotary link nut (2) | A100B1059F | 6 |
| Actuator Link Assy, inc. ball joints | B100B1004F | 4 |
| Nyloc Nut, M6, link to pod (2)<br>relay lever pivot (4)<br>relay lever/act. links (2)<br>pivot bracket to topshell (6) | A075W3009F | 14 |
| Adaptor, pivot bracket to topshell, RH | A100B1120S | 1 |
| Adaptor, pivot bracket to topshell, LH | A100B1121S | 1 |
| Setscrew, M5 x 30, adaptor to topshell | A079W1084F | 2 |
| Nut, Nyloc, M5, adaptor to topshell | A075W3008Z | 2 |
| Washer, flat, M5, adaptor to topshell | A075W4011Z | 2 |
| Pivot Bracket, relay lever | A100B1013F | 2 |
| Big Head Stud, pivot bracket fix | A100B6136F | 2 |
| Relay Lever, LH | A100B1009F | 1 |
| Relay Lever, RH | A100B1010F | 1 |
| Ball Joint | A100B0353F | 4 |
| Rivet, ball joint to relay lever | A100W6454F | 8 |
| Washer, relay lever pivot | A075W4014Z | 4 |
| Shelf Moulding, RH | A100B1022 | 1 |
| Shelf Moulding, LH | A100B1023 | 1 |
| Pan Head Screw, M6, shelf fixing | A076W5090Z | 4 |
| Jacknut, M6, shelf fixing | A075W3031Z | 4 |
| Washer, M6 x 15, shelf fixings (4)<br>relay lever pivot (4)<br>relay lever bracket (10) | A075W4015Z | 18 |
| Rotary Link, headlamp motor | F100B0298F | 2 |
| Nyloc ½ Nut, M6, act.link to rotary link | A907E6285F | 2 |
| Reinforcing Bracket, topshell to motor, LH | A100B0993 | 1 |

Continued.........

Parts Required (continued)

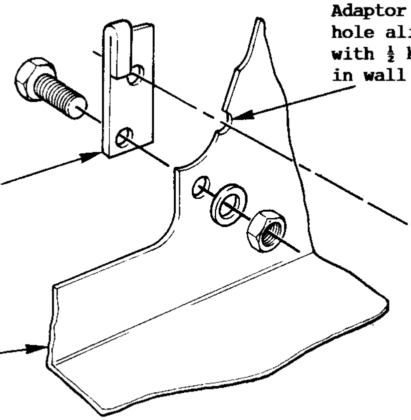
| **Description** | **Part Number** | **Qty** |
|---|---|---|
| Reinforcing Bracket, topshell to motor, RH | A100B0994 | 1 |
| Bolt, M5 x 50, reinf. brkt. to motor | A079W2026F | 2 |
| Nut, Nyloc, M5, brkt. to motor | A100W3113F | 2 |
| Slotted Shim Washer, shutline adjust | A100B0613F | 10 |
| 'P' Clip, harness to pod rear wall | A075W6000Z | 4 |
| 'P' Clip, harness to headlamp assy. | A075W6004Z | 4 |

Procedure

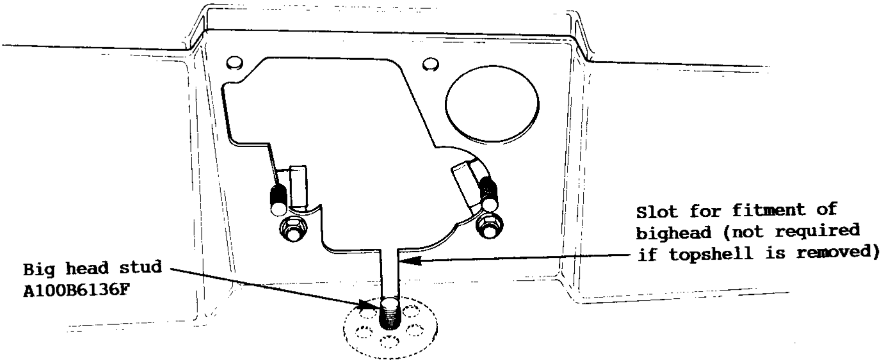
1. At each side, remove the existing headlamp pod system and retain the following parts:
   - Headlamp assemblies, including mounting rings.
   - Flap hinge bracket (bolted to topshell), but remove and discard the four upstop adjuster screws.
   - Headlamp motor and mounting bracket. Discard the rotary link but retain the spacer sleeve.

2. Release the headlamp harness from each pod well. Fettle the rear wall of each pod well using the template supplied (see later). Cut off the rearmost of the three big head studs used to secure the old headlamp mounting frame.

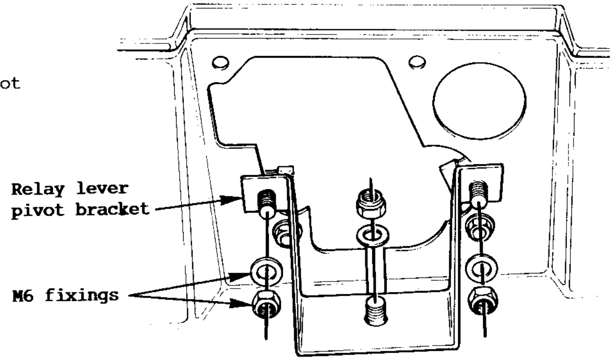
3. In order to make good the two fixing holes for the new relay lever mounting bracket, fit adaptor plates A100B1120 and A100B1121 behind the rear wall using the M5 fixings.



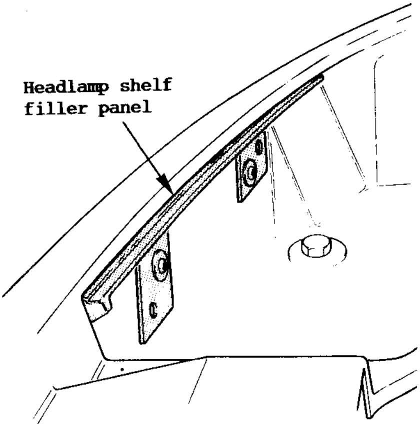
4. At each side, position the relay lever pivot bracket with the two top holes aligned, and sitting squarely on the base. Mark out the bracket lower fixing hole on the base of the pod well, and drill a 6 mm clearance hole in the topshell. Extend this hole into an open slot rearwards into the rear wall aperture. Apply a two part epoxy adhesive (e.g. Araldite) to 'big head' stud A100B6136F, and slide beneath the topshell to the front end of each slot, taking care not to allow excess adhesive to bond to the chassis. Clamp into position with a washer and nut on the top side until the adhesive has fully cured.


Big head stud
A100B6136F
Slot for fitment of
bighead (not required
if topshell is removed)

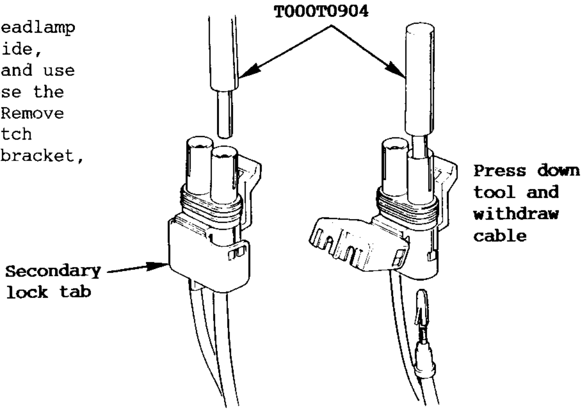
5. Fit the relay lever pivot bracket to the topshell using M6 nyloc nuts and flat washers.


Relay lever
pivot bracket
M6 fixings

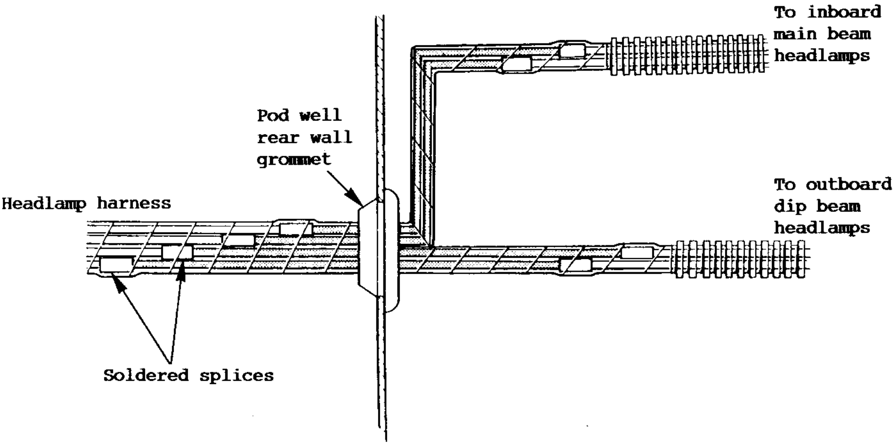
6. Position the headlamp shelf (filler panel) at the front of each pod well, and mark out the two fixing holes on the topshell. Drill the holes 11.0 mm and fit the two M6 jacknuts. Secure the two shelf panels with the pan head screws.


Headlamp shelf
filler panel

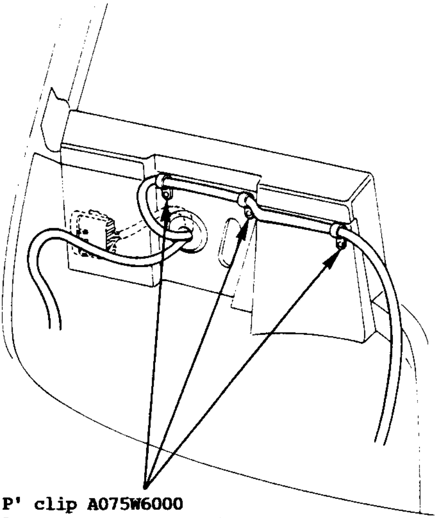
7. At the front harness to headlamp motor connector at each side, open the secondary lock, and use tool T000T0904 to transpose the green and slate cables. Remove and discard the micro-switch from each motor mounting bracket, and tape back the harness connections.


T000T0904
Press down tool and withdraw cable
Secondary lock tab

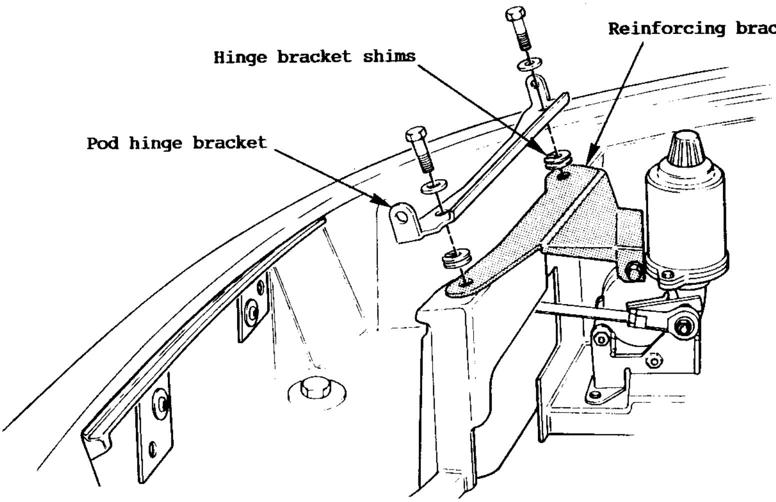
8. At each side, extend the two main beam headlamp leads by 90 mm, and the two dip beam leads by 120 mm:
   - Untape the headlamp harness for a distance of 100 mm from the main/dip branch out.
   - At a point 20 mm from the old branch out, cut the main beam feed wire (blue/black on RHS, blue/slate on LHS) and extend 90 mm using 2.0 mm blue cable, soldered splices, heat shrink insulation and tape.
   - Repeat for the main beam earth lead using 1.25 mm black cable, staggering the splice by 20 mm from the feed cable splice.
   - Repeat the above two operations for the dip beam feed (blue/orange RH, blue/pink LH) and earth cables, using 120 mm of red 2.0 mm, and 1.25 mm black cable.


To inboard main beam headlamps
Pod well rear wall grommet
To outboard dip beam headlamps
Headlamp harness
Soldered splices

- Secure the harness with 'P' clips along the back of the pod well as shown in the diagram.

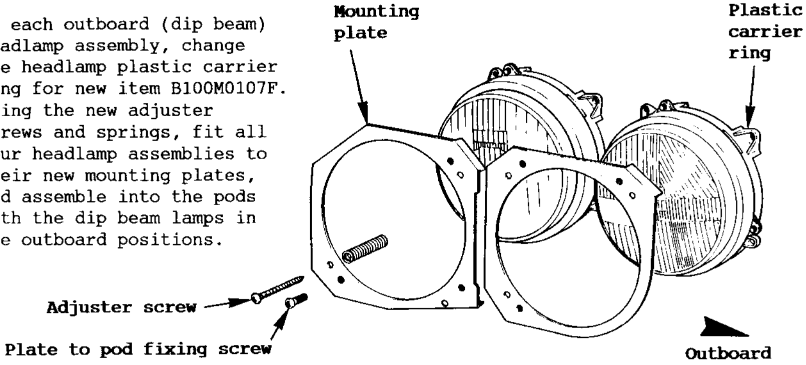

**RH pod shown**
**(LH sym. opposite)**
**'P' clip A075W6000**
**along back of pod well**

9. If a reinforcing bracket was not previously fitted between the topshell plinth at the top rear of each pod well and the headlamp motor, these brackets must now be fitted in order to brace the mounting plinth for the headlamp pods.


**Reinforcing bracket**
**Hinge bracket shims**
**Pod hinge bracket**

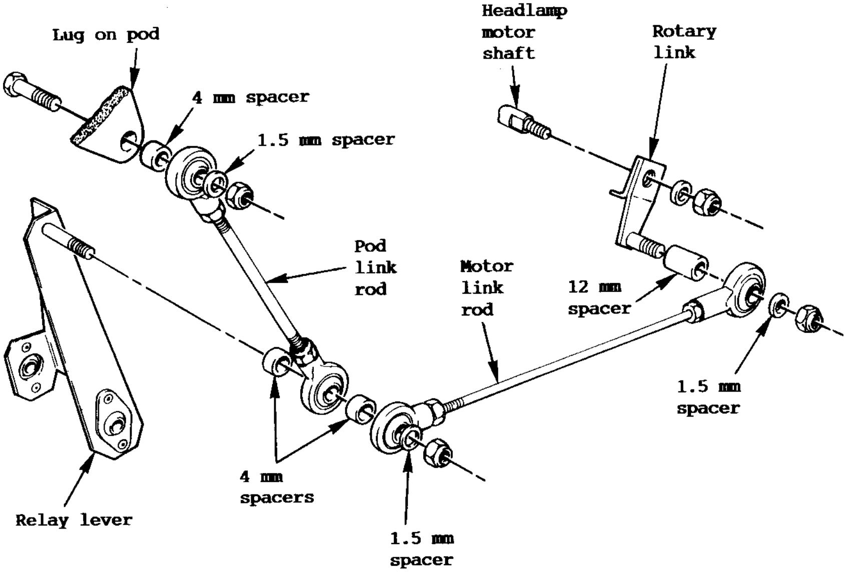
The reinforcing bracket should fit directly against the topshell, with the pod hinge bracket shims (if required) between the hinge bracket and reinforcing bracket.

10. On each outboard (dip beam) headlamp assembly, change the headlamp plastic carrier ring for new item B100M0107F. Using the new adjuster screws and springs, fit all four headlamp assemblies to their new mounting plates, and assemble into the pods with the dip beam lamps in the outboard positions.

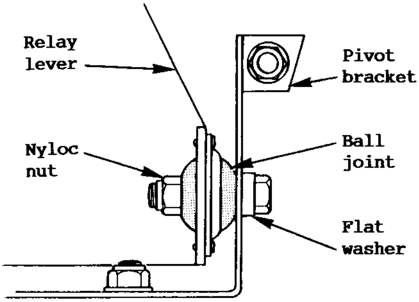

Mounting plate
Plastic carrier ring
Adjuster screw
Plate to pod fixing screw
Outboard

11. Remove the rotary link from each headlamp motor, and fit the new link.

12. Assemble a link rod with two rod ends and locknuts and fit to the inboard side of the pod lift bracket (bonded to the inside of the pod) with a 4.0 mm spacer between the rod end and bracket, and a 1.5 mm spacer between the rod end and nyloc nut. Repeat for the other pod.


Lug on pod
4 mm spacer
1.5 mm spacer
Headlamp motor shaft
Rotary link
Pod link rod
Motor link rod
12 mm spacer
1.5 mm spacer
Relay lever
4 mm spacers
1.5 mm spacer

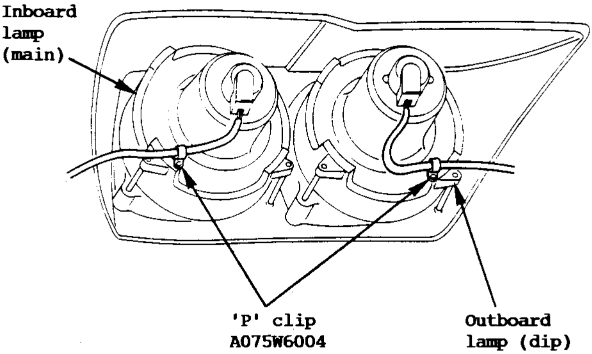
13. Fit two ball joints to each relay lever using pop rivets, with the ball joint flange on the outside of the lever. Assemble each lever into its pivot bracket with the open side facing forward and the actuator link stud pointing inboard.
    Fit the pivot bolts as shown.



14. Fit each pod to its hinge bracket, and tighten the ball joint socket head pivot screws. Adjust the pod shutlines and height by slackening the two bolts securing the hinge bracket to the topshell, and adding or deleting slotted shim washers as necessary to achieve flush fitting and a 5 mm (approx) shut gap between pod and topshell or bonnet.

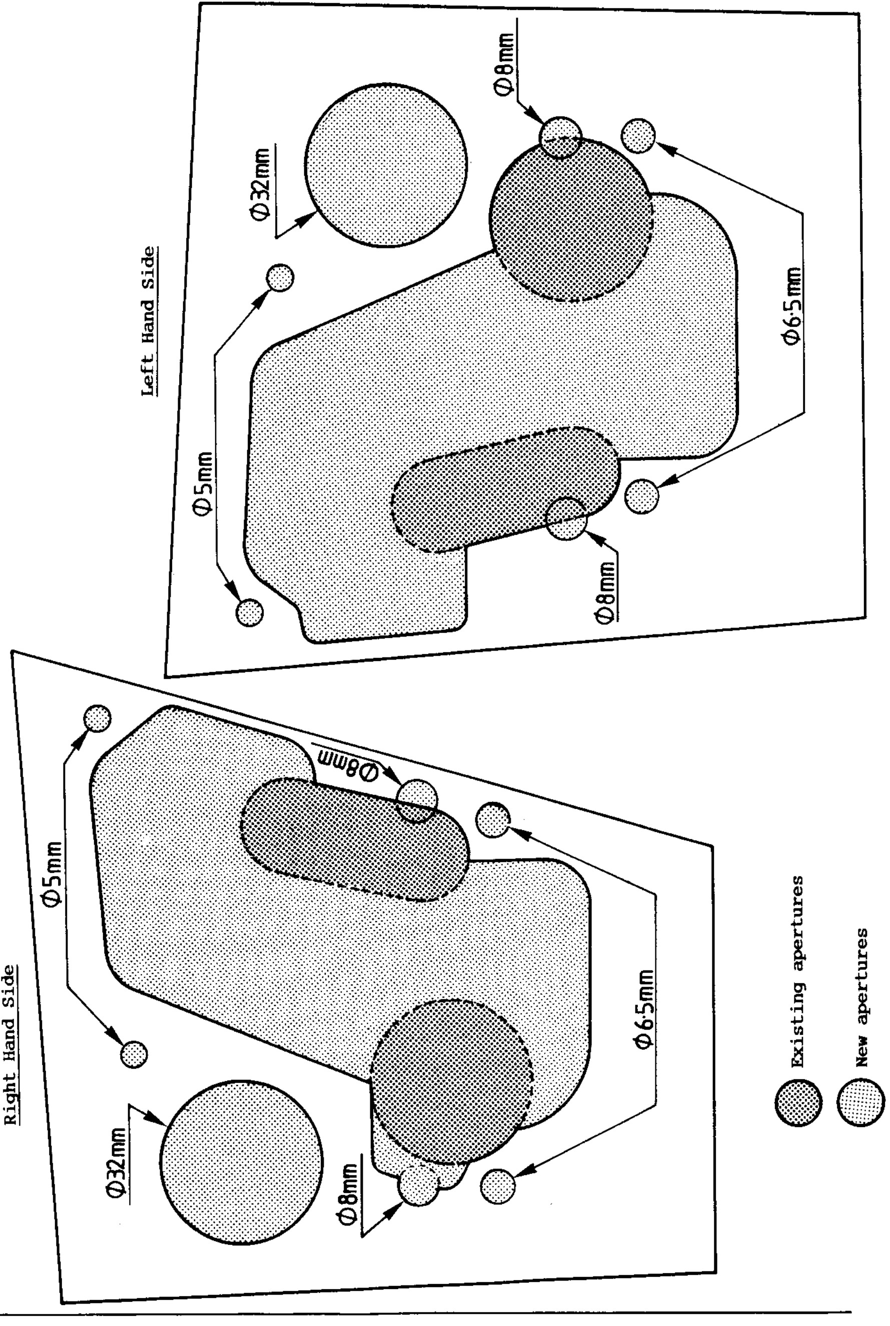
15. Fit the pod link rod onto the relay lever with a 4 mm spacer each side of the ball joint. Assemble the motor link rod, and adjust to a length of 140 mm between ball joint centres before fitting onto the relay lever followed by a 1.5 mm spacer and nyloc nut. Fit the other end onto the motor rotary link against the 12 mm spacer, and follow with a 1.5 mm spacer and nyloc ½ nut. With the rotary link abutting the downstop (rearmost stop on the motor mounting bracket), check the height of the pod front edge. If necessary, adjust the height by altering the length of the pod link before tightening the ball joint locknuts ensuring that the ball joints are parallel to each other.

16. Connect the headlamp leads, and secure the harnesses to the back of the headlamps using 'P' clips as shown. Check the operation of the headlamps, and ensure that the harness is not strained, chafed or trapped at any stage of headlamp pod operation.



17. Adjust headlamp alignment using a beam setter.

## POD WELL FETTLING TEMPLATES

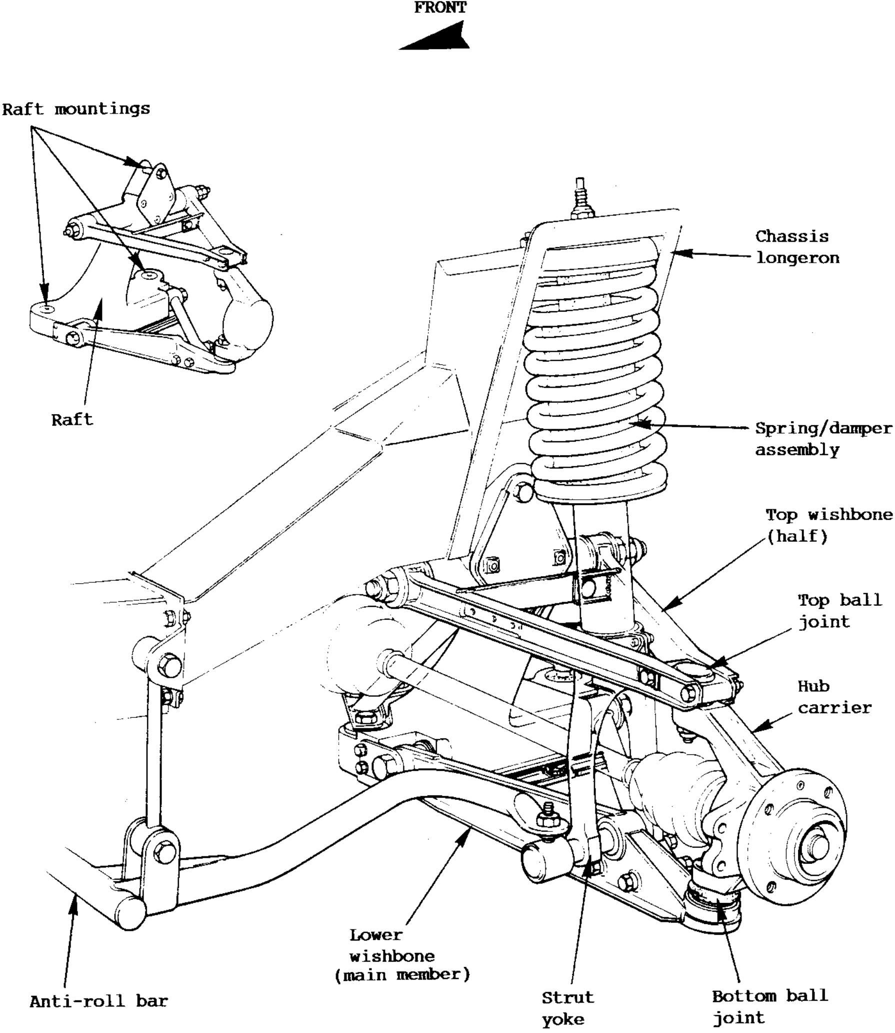

Left Hand Side
Φ32mm
Φ8mm
Φ5mm
Φ6·5mm
Φ8mm
Right Hand Side
Φ5mm
Φ8mm
Φ6·5mm
Φ32mm
Φ8mm
Existing apertures
New apertures

# FRONT SUSPENSION

## SECTION CE - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | CE.1 | 3 |
| Geometry | CE.2 | 3 |
| Adjustments | CE.3 | 4 |
| Suspension Disassembly | CE.4 | 6 |
| Suspension Re-assembly | CE.5 | 9 |
| Hub Bearing Replacement | CE.6 | 10 |

## Front Suspension General Layout


FRONT
Raft mountings
Raft
Chassis longeron
Spring/damper assembly
Top wishbone (half)
Top ball joint
Hub carrier
Anti-roll bar
Lower wishbone (main member)
Strut yoke
Bottom ball joint

## CE.1 - GENERAL DESCRIPTION

The front suspension comprises of upper and lower wishbones with concentric coil spring/telescopic damper unit and an anti-roll bar. The upper and lower wishbones on each side of the car are mounted on a separate cast alloy 'raft' (subframe) which is itself mounted to the chassis on three bonded rubber bushes, and helps to isolate the body from suspension noise and harshness, whilst maintaining accurate wheel control.

The lower wishbone uses a main fabricated steel track control arm to carry the spring/damper unit, and, at its outboard end, the lower steering swivel ball joint. A separate tubular steel strut is bolted to this member, and leads rearwards to form a wishbone. The upper wishbone comprises two similar pressed steel links, bolted together at their outboard end where they sandwich the top steering swivel ball joint. Both upper and lower ball joints are secured to a cast iron hub carrier with integral rearward facing steering arm. The co-axial coil spring/damper unit uses a two piece yoke at its lower end to straddle the driveshaft. A forward mounted tubular anti-roll bar, picks up off the damper lower mount, and is supported by two hanging links. The coil spring/ damper unit is secured at its upper end, to the chassis longeron.

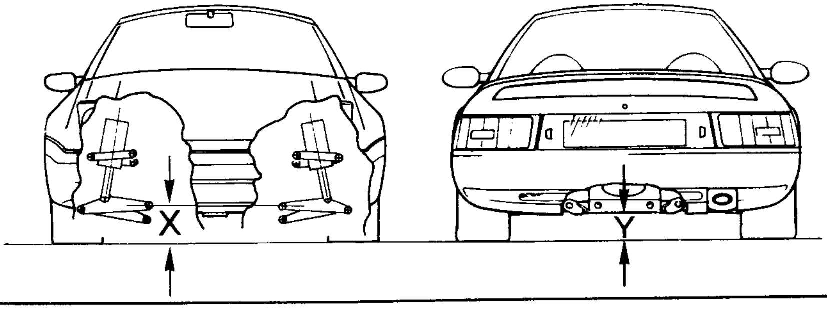
The inboard pivots of the upper and lower wishbones, take the form of bonded rubber bushes with longitudinal pivot axes. These bushes are anchored to separate cast aluminium alloy 'rafts' on each side of the car which serve to transfer all the longitudinal, lateral and torque loadings from the front suspension, into the chassis. Each raft is mounted to the chassis by three bonded rubber bushes, the lower two having vertical axes, and the single top bush having a transverse axis. The lower rear bush is bolted directly to the chassis front crossmember, the lower front bush to the detachable underframe, and the top bush, via sandwich plates, to the chassis longeron. The compliance of the raft rear bush is sufficiently soft in order that on meeting a sharp bump, the front wheel is allowed to move back slightly as the raft pivots about its upper and front lower bushes. This movement has only a minimal effect on the steering, but significantly reduces the noise and harshness transmitted to the cabin. This feature allows for stiffer wishbone bushes to be used, in order to maintain accurate wheel control for optimum handling.

The hub carrier uses a single, double row ball bearing to support the wheel hub, into which is fitted the driveshaft.

## CE.2 - GEOMETRY

Ride height at kerb condition (full fuel tank, no occupants)

| | | |
|---|---|---|
| - front (X) | 170 ± 2 mm ] | **NOT** ride height for |
| - rear (Y) | 160 ± 2 mm ] | geometry check |



Suspension and steering geometry should be checked only at **mid-laden** ride height:

| | | | |
|---|---|---|---|
| Ride height - front (X) | 165 ± 2 mm | mid-laden | (with 75 kg driver |
| - rear (Y) | 154 ± 2 mm | mid-laden | + ½ tank of fuel) |
| Castor: | + 1°; + ½°, - 0 | | |
| Camber: | - ¼°; ± ¼° | | |
| Steering axis inclination: | 10½° | | |
| Toe-out: | 0° to ¼° total | | |
| Scrub radius: | - 3 mm | | |

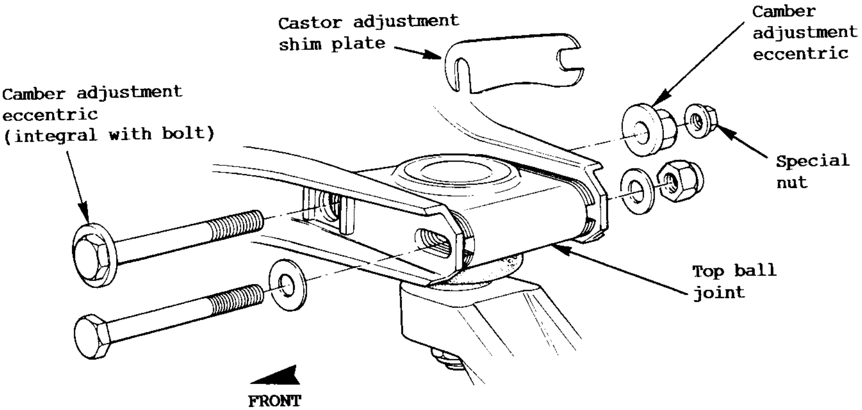
## CE.3 - ADJUSTMENTS

Castor, camber and toe-out are adjustable, and should be checked and/or adjusted in the following order:

Castor: Castor adjustment shims are fitted between the top ball joint and the two top wishbone arms. A total of eight 1 mm shims must always be maintained, but may be transferred between front and back of the ball joint as required. Transferring a single 1 mm shim from front to back of the joint will reduce castor by approx. ½°. Ensure the shims are fitted the correct way up so that the ball joint boot is not damaged by the shim.

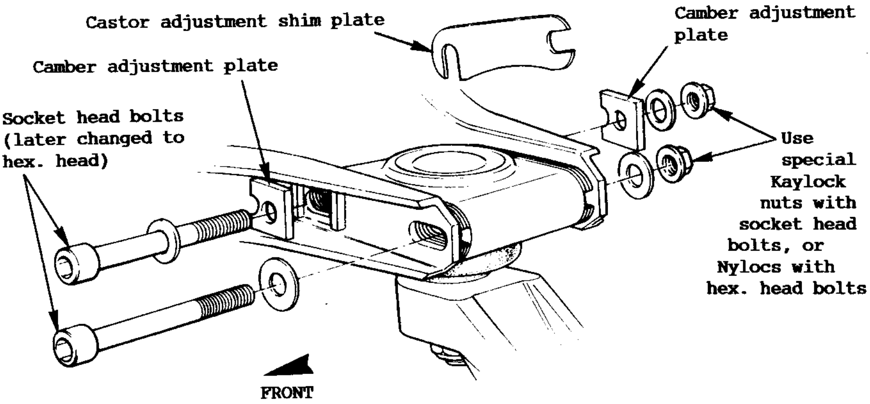
Camber: Provision is made for the adjustment of wheel camber at the top swivel joint to wishbone fixing. Two bolts are used to clamp the two halves of the top wishbone to the swivel joint. Both fixing points use slotted holes in the wishbone arms, with either an eccentric or square plate camber adjuster incorporated at the inboard fixing.

On early cars, the top swivel joint inboard bolt used an integral eccentric washer under its head to locate between two vertical guides on the front half of the wishbone. A similar arrangement on the rear half of the wishbone used a separate eccentric washer to mirror the position of the bolt eccentric.


Castor adjustment shim plate
Camber adjustment eccentric
Camber adjustment eccentric (integral with bolt)
Special nut
Top ball joint
FRONT

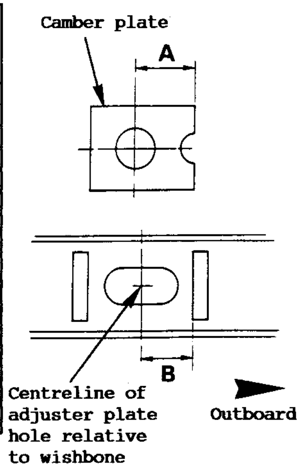
To make an adjustment with the eccentric type fixings, first slacken the outboard bolt, and then slacken the nut of the inboard bolt whilst holding the bolt stationary. Turn the bolt (with integral eccentric) and rear eccentric together, as necessary to increase or decrease camber. Ensure that both eccentrics are turned the same amount, and that the position of one is mirrored by the other. A total adjustment of about 1.8° is available. On completion, torque both nuts to 22 - 25 Nm (16 - 18 lbf.ft).

On later cars, camber adjustment plates are fitted between the guides at the top swivel joint inboard fixing. Four variations of plate provide seven settings according to the orientation of the plates, and allow for a camber adjustment range of about 3° in steps of just under ½°.


Castor adjustment shim plate
Camber adjustment plate
Socket head bolts (later changed to hex. head)
Camber adjustment plate
Use special Kaylock nuts with socket head bolts, or Nylocs with hex. head bolts
FRONT

To make an adjustment on cars with camber adjustment plates, first establish the variation of plate fitted before selecting an alternative plate, and/or orientation, from the table below. Slacken the top swivel joint outer fixing, and remove the inboard fixing bolt. Fit the replacement adjuster plates into the guides on the top wishbone halves (making sure that the same plates are fitted at front and rear) and fit and tighten the fixings: Socket head bolts; 35 - 39 Nm (26 - 29 lbf.ft). Hex. head bolts; 22 - 25 Nm (16 - 18 lbf.ft). (Alternatives)

| Dimension 'A' | Part no. of plate | Plate orientation | Dimension 'B' | |
|---|---|---|---|---|
| | | Outboard ► | | negative camber increases ↓ |
| 14.0 mm | A100C0111 | )○ | 7.0 mm | |
| 12.5 mm | A100C0110 | )○ | 8.5 mm | |
| 11.5 mm | A100C0125 | )○ | 9.5 mm | |
| 10.5 mm | A100C0109 | ○( )○ | 10.5 mm | |
| 11.5 mm | A100C0125 | ○( | 11.5 mm | |
| 12.5 mm | A100C0110 | ○( | 12.5 mm | |
| 14.0 mm | A100C0111 | ○( | 14.0 mm | |


Camber plate
A
B
Centreline of adjuster plate hole relative to wishbone
Outboard

Earlier cars with eccentric adjusters may be fitted with the later type camber adjuster plates, but only in conjunction with the inboard and outboard socket head fixing bolts, nuts and washers, and the higher fixing torque (see above)

Toe-out: To adjust the toe-out, hold each track rod end by the flats provided (22 mm) whilst releasing the locknut. Turn each track rod, using the flats provided (13 mm) an EQUAL amount, to adjust the effective track rod length as necessary. When adjustment is correct, hold the track rod end and tighten the locknut to 60 Nm (44 lbf.ft).

## CE.4 - SUSPENSION DISASSEMBLY

If the complete suspension assembly is to be removed from one side of the car in order to provide access, or for other work in that area to be performed, the complete wishbone/hub carrier assembly may be removed by releasing the cast alloy raft from the chassis:

### Complete Suspension Assembly

1. Track Rod End: Remove the nut securing the track rod end to the steering arm, and use a ball joint seperator to release the joint.

2. Driveshaft & Brake Caliper: Unpeen, remove and discard the hub nut. Release the brake caliper from the hub carrier, and the flexible hose from the top wishbone, and support clear, without straining the hose.

3. Strut Yoke: Release the end of the anti-roll bar from the ball joint, and whilst supporting the weight of the suspension, release the nut and withdraw the bolt securing the strut yoke to the lower link. Release the four bolts, and remove the two halves of the yoke from the suspension strut.

3. Driveshaft & Brake Caliper: Unpeen, remove and discard the hub nut. Release the brake caliper from the hub carrier, and the flexible hose from the top wishbone, and support clear, without straining the hose.

4. Top Raft Fixing: Release the three bolts securing the sandwich plates to the top of the raft, and the single bolt through the top mounting. Remove the two plates.

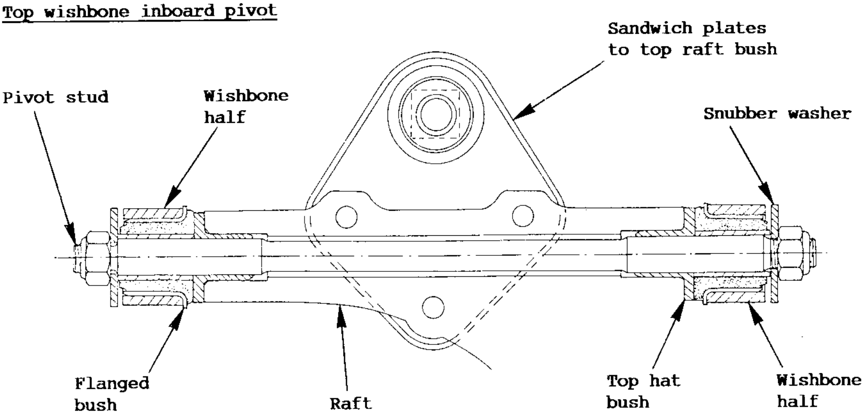
5. Lower Raft Fixings: Release the raft lower front mounting bolt, and lower rear mounting bolt. Push the driveshaft out of the hub, and withdraw the complete wishbone suspension assembly from the car. Note: take care not to 'stretch' the driveshaft, and pull apart the inboard joint.

### Spring/Damper Assembly

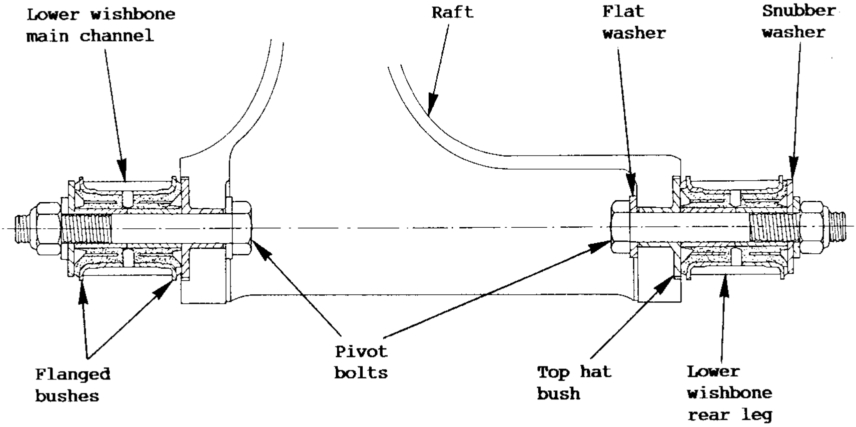
The spring/damper assembly uses a spring top seat which is bolted to the chassis, and also retains the top of the damper strut. This allows the complete assembly to be withdrawn from the vehicle without the use of spring compressors: With the suspension 'hanging', release the yokes from the lower end of the damper body, and remove the three nuts securing the spring top seat to the chassis. Withdraw the damper and spring assembly. Do NOT remove the damper stem top nut without first fitting spring compressor clamps.

Before re-assembling the unit, ensure that the damper stem rubber bushes, and the spring top rubber seat are in good condition. Replace if necessary. Pay careful attention to the correct location of the damper stem bushes and washers -

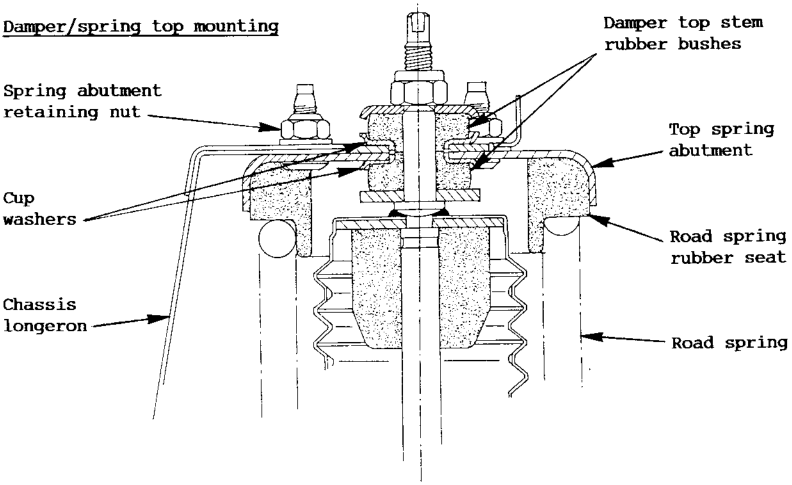
## Top wishbone inboard pivot


Sandwich plates to top raft bush
Pivot stud
Wishbone half
Snubber washer
Flanged bush
Raft
Top hat bush
Wishbone half

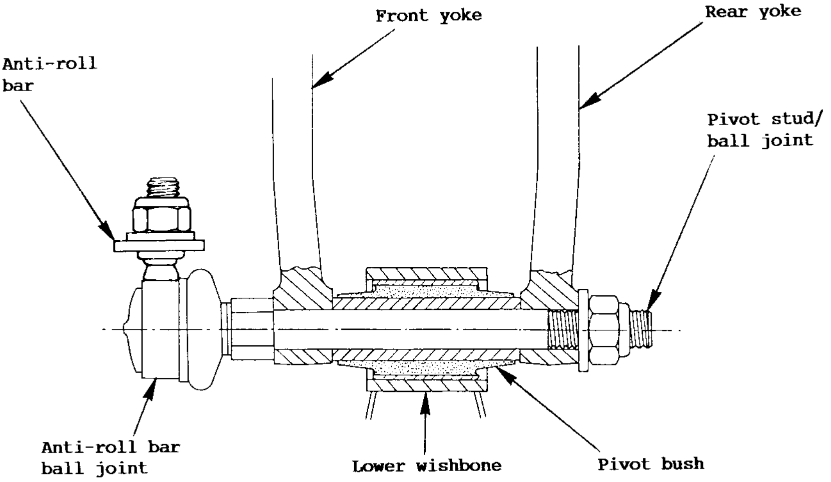
## Lower wishbone inboard pivot


Lower wishbone main channel
Raft
Flat washer
Snubber washer
Flanged bushes
Pivot bolts
Top hat bush
Lower wishbone rear leg

Damper/spring top mounting


Damper top stem
rubber bushes
Spring abutment
retaining nut
Top spring
abutment
Cup
washers
Road spring
rubber seat
Chassis
longeron
Road spring

Spring/damper assembly to lower wishbone


Front yoke
Rear yoke
Anti-roll
bar
Pivot stud/
ball joint
Anti-roll bar
ball joint
Lower wishbone
Pivot bush

refer to the sectional illustration. Hold the top of the stem whilst torque tightening the stem nut to 20 - 30 Nm (15 - 22 lbf.ft).

Bush Replacement

1. Lower Wishbone: The inboard pivots of the lower wishbone (in both main link, and tubular steady link) are split, flanged sleeve, bonded rubber bushes, which may be drawn or pressed from the wishbone before new items are pressed into position.
   The sleeved bush for the suspension strut to lower wishbone may be replaced using a press with a suitable sleeve tool.

2. Top Wishbone: The inboard end of each top wishbone half, is fitted with a flanged sleeve bonded rubber bush which may be replaced using a press. Note that the bush is fitted from the **inside** of the arm.

3. Raft: The raft front bush is a split, flanged sleeve type, which may be prised out, and new bushes pressed in.
   The raft rear bush is a single flanged sleeve type, fitted from below.
   The raft top mounting is a split, flanged sleeve, bonded rubber bush, pressed into the chassis longeron, and may be removed by drawing/pressing out each half of the bush in turn.

## CE.5 - SUSPENSION RE-ASSEMBLY

Note the following points when re-assembling the suspension:

i) Use a copper based grease on the shank of the top wishbone to raft fixing stud to prevent corrosion, and aid subsequent disassembly. Thoroughly degrease the threads before fitting the nyloc nuts.

ii) Tighten the wishbone pivot bolts and damper to lower wishbone fixing bolt ONLY with the car at normal ride height, otherwise the bonded bushes will be preloaded, resulting degraded ride quality, premature wear and increased ride height.

iii) Pay careful attention to the correct assembly of the snubber washers and ensure that the steel inserts are fitted into the alloy suspension carrier at the wishbone pivot points.

iv) Note that no washers are used beneath the heads of the upper and lower swivel joint nuts, or the track rod end ball joint nut.
**It is most important that the ball joint nuts are correctly torqued,** especially the bottom ball joint for which an open ended torque wrench must be used, or alternatively, remove the driveshaft to allow access with a socket wrench.

v) When assembling the bottom wishbone, torque tighten the two bolts securing the tubular strut to the main member before tightening the two fixings joining the bracing channel. Note that on later cars with 15" wheels, the inboard of the two main fixing points, is reamed to take a 7/16" UNF bolt rather than the M10 bolt used on other cars.
Similarly, on cars with 16" wheels and some 15" wheel cars with a top wishbone bracing channel, tighten the wishbone to top swivel joint bolts, before tightening the bracing channel bolt.

vi) After re-assembly, carry out a geometry check, and make any adjustments as necessary as detailed in CE.3.

vii) Refit the brake caliper (see section JE.5).

viii) Torque tighten all fixings as below.

ix) Tighten the raft to chassis front crossmember strut (both ends), with the vehicle weight supported on its wheels.

| | Torque Settings | Nm | lbf.ft |
|---|---|---|---|
| 1. | Raft top mounting bolt | 75 - 80 | 55 - 59 |
| 2. | Sandwich plate to raft | 22 - 25 | 16 - 18 |
| 3. | Raft front and rear mounting bolts | 75 - 80 | 55 - 59 |
| 4. | Top wishbone inboard pivot | 55 - 58 | 41 - 43 |
| 5. | Top wishbone to ball joint | | |
| | - eccentric camber adjusters | 22 - 25 | 16 - 18 |
| | - square plate camber adjusters | 35 - 39 | 26 - 29 |
| 6. | Top wishbone bracing channel | 45 | 33 |
| 7. | Lower wishbone inboard pivot bolt | 68 - 72 | 50 - 53 |
| 8. | Lower wishbone inboard pivot end plate | 22 - 25 | 16 - 18 |
| 9. | Lower wishbone strut to main member - M10 | 41 - 45 | 30 - 33 |
| | - 7/16" UNF | 61 - 81 | 45 - 60 |
| 10. | Lower wishbone bracing channel | 37 | 27 |
| 11. | Suspension strut yoke to lower wishbone | 105 - 110 | 77 - 81 |
| 12. | Ball joint to anti-roll bar | 25 - 27 | 18 - 20 |
| 13. | Damper top stem nut | 20 - 30 | 15 - 22 |
| 14. | Yoke to damper | 35 - 38 | 26 - 28 |
| 15. | Spring top seat to chassis | 22 - 25 | 16 - 18 |
| 16. | Lower swivel joint to hub carrier | 61 - 67 | 45 - 49 |
| 17. | Top swivel joint to hub carrier | 61 - 67 | 45 - 49 |
| 18. | Track rod end to steering arm | 58 - 64 | 43 - 47 |
| 19. | Driveshaft to front hub | 225 - 235 | 166 - 173 |

## CE.6 - HUB BEARING REPLACEMENT

1. Hub Nut: Unpeen, remove and discard the hub nut.

2. Brake Caliper: Prise off the dust caps covering the ends of the two caliper sliding pins, and remove the two socket head bolts securing these pins, and the brake caliper, to the hub carrier. Support the caliper clear of the brake disc without straining the flexible hose.

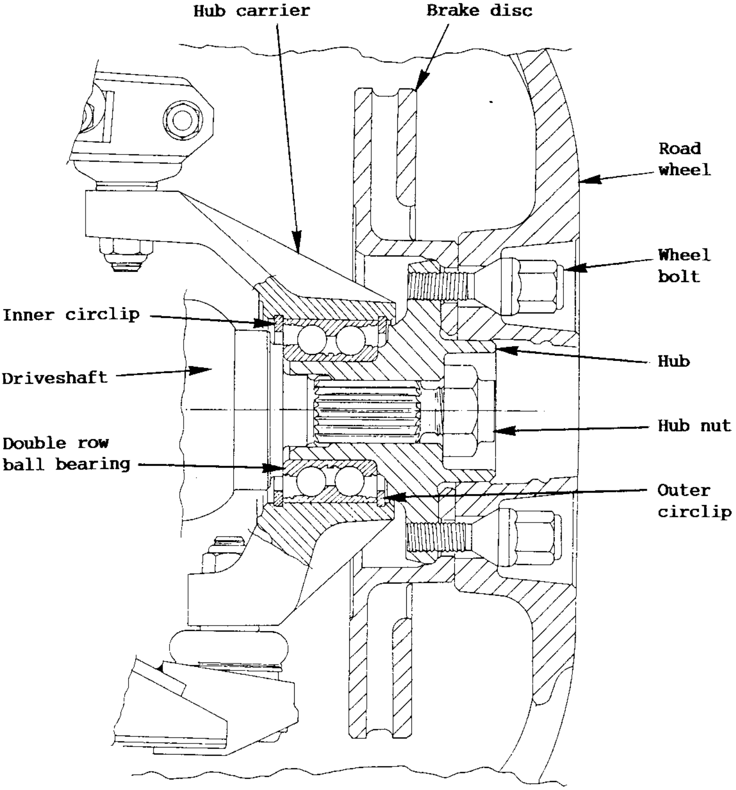
3. Brake Disc: Release the single screw securing the brake disc, and withdraw the disc from the hub.

4. Ball Joints: Separate the steering track rod end, and top and bottom swivel joints from the hub carrier, by removing the ball joint nut, and using a suitable ball joint splitter tool.

5. Hub Carrier: Press the driveshaft out of the hub as the hub carrier assembly is removed to the bench. Take care not to 'stretch' the driveshaft, and pull apart the inboard C.V. joint.

6. Hub & Bearing: Use a split collar tool to support the hub carrier on a hydraulic press, and press the hub from the bearing. Remove the two circlips securing the bearing in the hub carrier, and press out the bearing outer race.

7. Assemble Hub: Fit the outer circlip into the hub carrier, and press the hub bearing, via the outer race, into the hub carrier. Fit the inner circlip. Press the hub bearing, via the inner race, onto the hub.

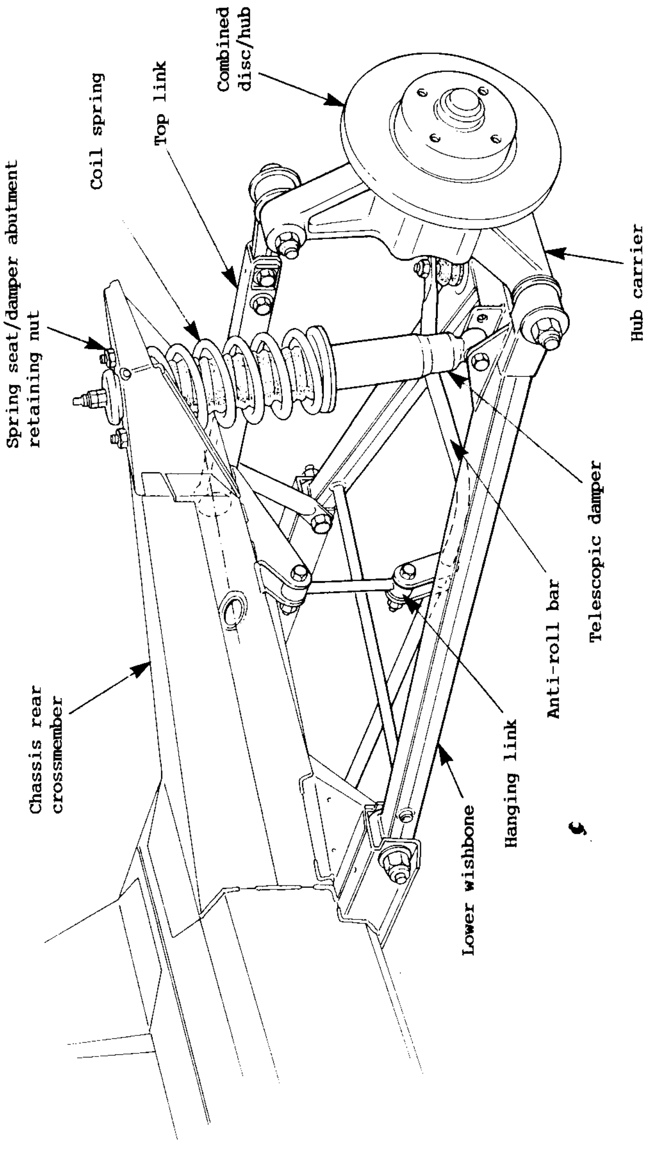

Hub carrier
Brake disc
Road wheel
Wheel bolt
Inner circlip
Driveshaft
Hub
Hub nut
Double row ball bearing
Outer circlip

8. Refit Hub Carrier: Refit the hub carrier reversing the removal procedure, and noting the following points:
   - Use a new hub nut, and peen into the driveshaft slot after torquing.
   - Use an open ended torque spanner to tighten the top and bottom ball joint nuts to their specified torque.
   - Fit new dust caps over the brake caliper mounting bolts/sliding pins.
   - Refit the brake caliper (see section JE.5).
   - Tighten all fixings to the specified torque.

# REAR SUSPENSION

## SECTION DD - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | DD.1 | 3 |
| Geometry | DD.2 | 3 |
| Adjustments | DD.3 | 4 |
| Suspension Disassembly | DD.4 | 5 |
| Suspension Re-assembly | DD.5 | 8 |
| Hub Bearings | DD.6 | 10 |


Spring seat/damper abutment retaining nut
Coil spring
Top link
Combined disc/hub
Hub carrier
Telescopic damper
Anti-roll bar
Hanging link
Lower wishbone
Chassis rear crossmember

## DD.1 - GENERAL DESCRIPTION

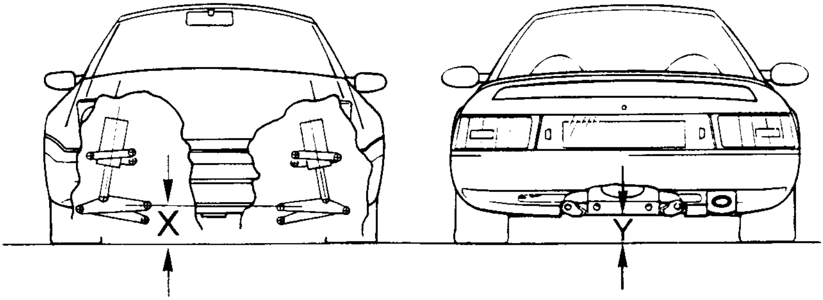
The rear suspension consists of a wide based lower wishbone, a single top link, a concentric coil spring/telescopic damper and an anti-roll bar. The box section fabricated steel lower wishbone, transfers the lateral loads and brake torque into the chassis, and also controls the rear wheel toe-in. The single inverted U-section top link controls wheel camber. The telescopic damper connects between the lower wishbone and the chassis, and incorporates the coil spring lower seat. The top end of the spring abuts against the chassis rear crossmember via a bolt on seat, into which is secured the top of the damper stem. The anti-roll bar is suspended forward of the rear axle line on two hanging links, and connects with each lower wishbone via ball joints.

A flanged stub axle is bolted to the aluminium alloy hub carrier, and supports the rear hub, which is integral with the brake disc, on a pair of taper roller bearings, adjustable for end float.

## DD.2 - GEOMETRY

Ride height at kerb condition (full fuel tank, no occupants):

| | | |
|---|---|---|
| - front (X) | 170 ± 2 mm ] | **NOT** ride height for |
| - rear (Y) | 160 ± 2 mm ] | geometry check |



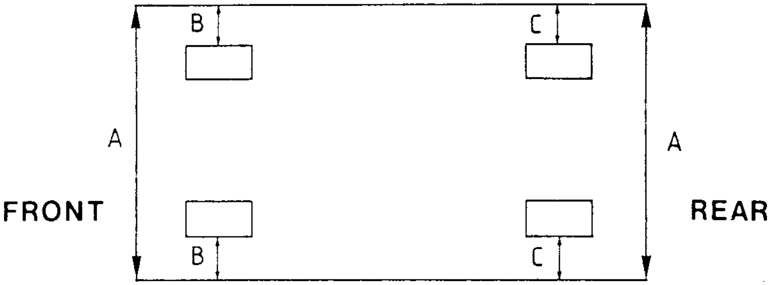
Suspension geometry should be checked only at **mid-laden** ride height:

| | | | |
|---|---|---|---|
| Ride height - front (X) | 165 ± 2 mm | mid-laden | (with 75 kg driver |
| - rear (Y) | 154 ± 2 mm | mid-laden | + ½ tank of fuel) |
| Camber: | - ½°; ± ¼° | | |
| Toe-in: | + 1.5 to 2.0 mm **each side** | | |

It is essential that rear wheel alignment is checked using equipment which measures individual wheel alignment. The most reliable and accurate method is considered to be the use of parallel bars, used as follows:

Two bars which are longer than the overall length of the car, and 4 axle stands are required. The bars should be obtained locally and should be of 'T' or square section and be sufficiently rigid to avoid significant bending or sagging between supports.

Set up the two bars on each side of the car at wheel centre height as shown in the diagram, so that A equals A, B equals B and C equals C.

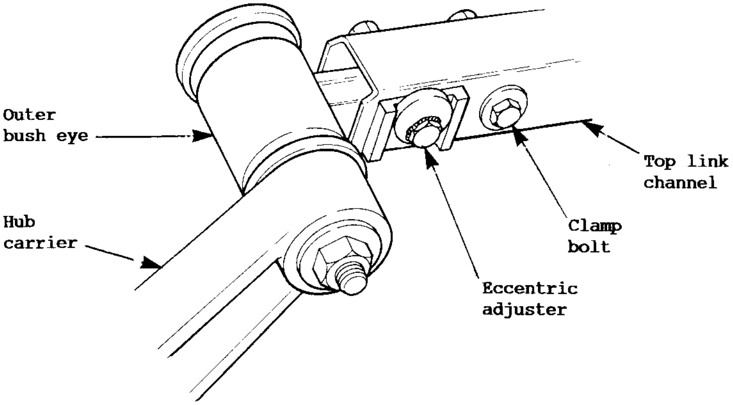


Measure the distance from the bar to the RIM of the wheel concerned at front and rear of the centre line of the wheel. If the front dimension is greater than the rear dimension, the wheel has TOE-IN. If the rear dimension is greater than the front dimension, the wheel has TOE-OUT. The difference between the two measurements is the amount the wheel has TOE-IN or TOE-OUT.

## DD.3 - ADJUSTMENTS

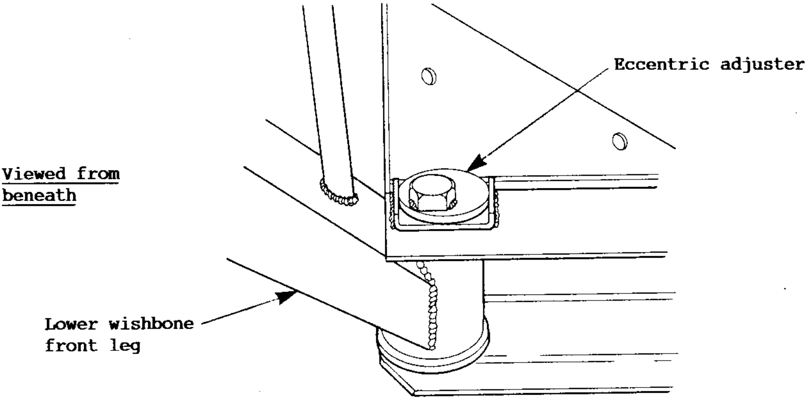
Camber and toe-in are adjustable.

Camber: Provision is made for the adjustment of wheel camber at the top link. The top link consists of an inverted U-section channel welded to the inboard bush eye, and a separate cast iron outer bush eye bolted to the channel with two bolts. Both fixings use a slotted hole in the channel section, with an eccentric adjuster incorporated at the outboard fixing. This bolt has an integral eccentric washer under its head which locates between two vertical guides on the front side of the channel. Plain washers and nuts are used on both bolts on the rear side of the link, and a plain washer beneath the head of the inboard bolt.



To make an adjustment, first slacken the inboard bolt, and then slacken the nut of the outboard bolt whilst holding the bolt stationary. Turn the bolt (with integral eccentric), as necessary to increase or decrease camber. A total adjustment of about 1.5° is available. On completion, torque both nuts to 22 - 25 Nm (16 - 18 lbf.ft).

Toe-in: Provision is made for the adjustment of toe-in, by an eccentric adjuster at the lower wishbone front fixing. To make an adjustment, slacken the forward fixing bolt nut, and turn the bolt (with integral eccentric) as required before re-tightening to 65 - 70 Nm (48 - 52 lbf.ft). A total adjustment of about 4.5 mm is available.



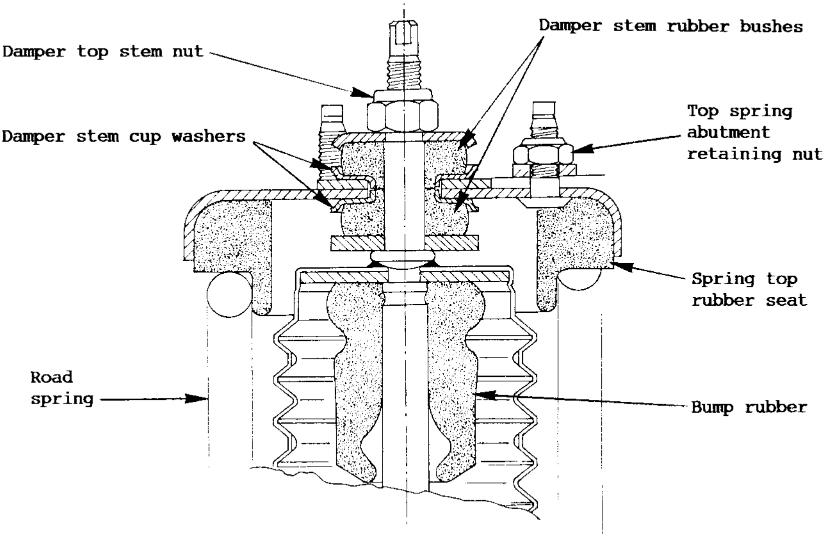
DD.4 - SUSPENSION DISASSEMBLY

The suspension strut assembly uses a spring top seat which is bolted to the chassis, thus allowing the complete strut assembly to be withdrawn from the vehicle without the use of spring compressors:

- support the weight of the suspension, and remove the bolt securing the lower end of the damper to the lower wishbone.
- remove the carpet from within the boot, and release the three nuts securing the spring top seat to the chassis. Withdraw the complete spring/damper assembly.
- do NOT remove the damper stem top nut without first fitting spring compressors clamps.

Before re-assembling the unit, ensure that the damper stem rubber bushes, and the spring top rubber seat are in good condition. Replace if necessary. Pay careful attention to the correct location of the damper stem bushes and washers. Hold the top of the stem whilst torque tightening the stem nut to 20 - 30 Nm (15 - 22 lbf.ft).

Note that if the lower wishbone is to be removed, the brake hose between chassis and wishbone should first be clamped off, and then disconnected from the wishbone.

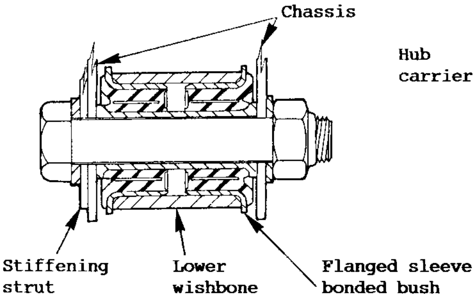

Damper top stem nut
Damper stem rubber bushes
Top spring abutment retaining nut
Damper stem cup washers
Spring top rubber seat
Road spring
Bump rubber

Bush Replacement

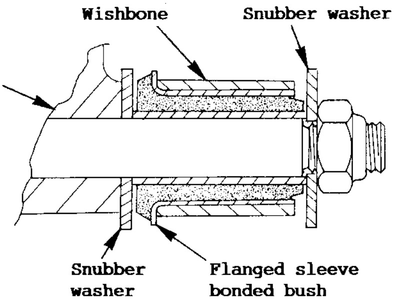
1. Lower Wishbone Inner Bush: Each inboard pivot of the lower wishbone is fitted with a pair of flanged sleeve bonded rubber bushes, which may be drawn or pressed out. New bushes may be pressed into position. Note that the front (hard) bush is colour coded orange, and the rear (soft) bush, white.

2. Lower Wishbone Outer Bush: Each outboard pivot of the lower wishbone is fitted with a single, flanged sleeve bonded rubber bush, which may be replaced using a press. Note that the bush is fitted from the **inside** of the wishbone.

**Lower wishbone inner bush**


Chassis
Stiffening strut
Lower wishbone
Flanged sleeve bonded bush

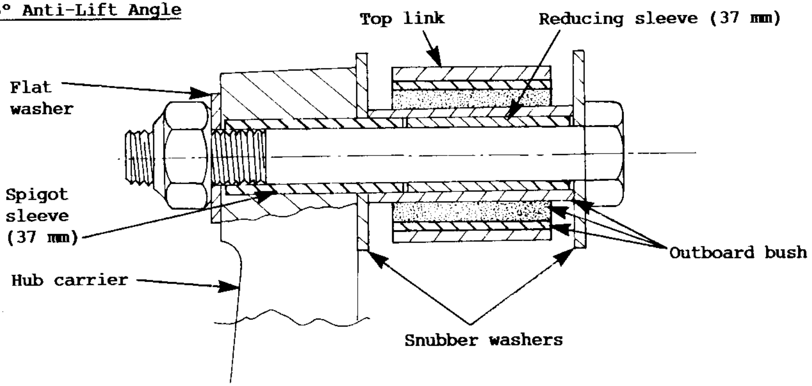
**Lower wishbone outer bush**


Wishbone
Snubber washer
Hub carrier
Snubber washer
Flanged sleeve bonded bush

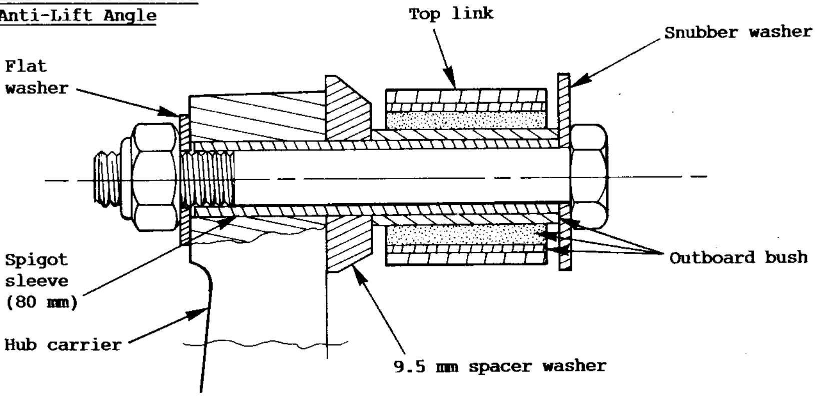
3. Damper Lower Eye: The damper uses a plain sleeved bonded rubber bush at its lower end, which may be replaced using a press.

4. Top Link Bushes: Note that the top link pivots are 'overhung' at both inner and outer ends, and for added security, each of the bonded rubber pivot bushes is located by a spigot.
   At the inboard end, a spigot, integral with the chassis, projects into the end of the top link bush, with a reducing sleeve within the bush to maintain the diameter for the fixing bolt.
   At the outboard end, a spigot sleeve is fitted into the hub carrier bore, and projects from the hub carrier to spigot into the top link bush. Two variations of this arrangment are used dependent on the 'anti-lift' angle. See below.
   Both bushes may be renewed using a press, but do not forget to fit the reducing sleeve into the inside bore where appropriate.

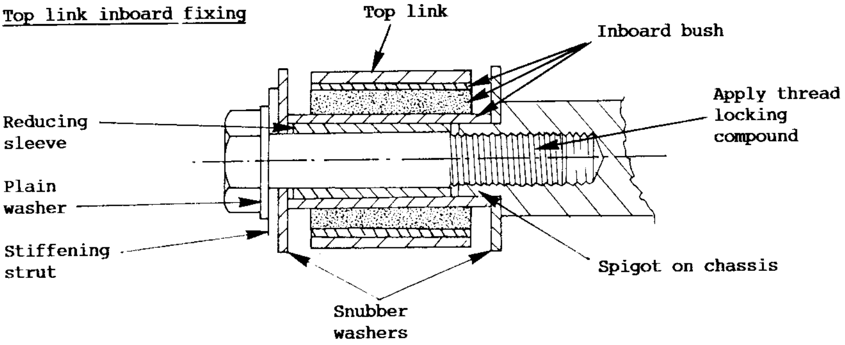
**Top Link to Hub Carrier**
**5° Anti-Lift Angle**


Top link
Reducing sleeve (37 mm)
Flat washer
Spigot sleeve (37 mm)
Outboard bush
Hub carrier
Snubber washers

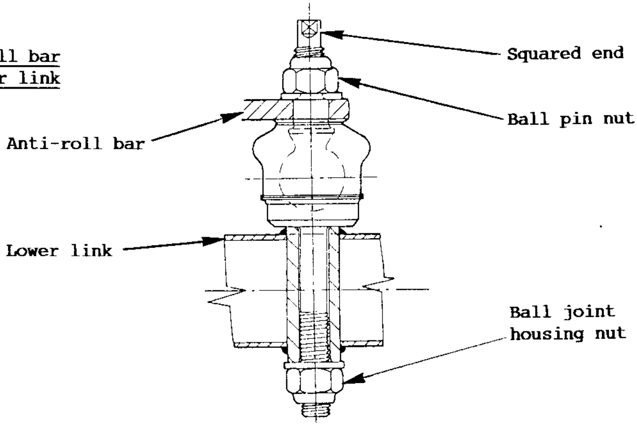
**Top Link to Hub Carrier**
**2½° Anti-Lift Angle**


Top link
Snubber washer
Flat washer
Spigot sleeve (80 mm)
Outboard bush
Hub carrier
9.5 mm spacer washer

Top link inboard fixing


Top link
Inboard bush
Apply thread locking compound
Reducing sleeve
Plain washer
Stiffening strut
Spigot on chassis
Snubber washers

Anti-roll bar to lower link


Squared end
Ball pin nut
Anti-roll bar
Lower link
Ball joint housing nut

DD.5 - SUSPENSION RE-ASSEMBLY

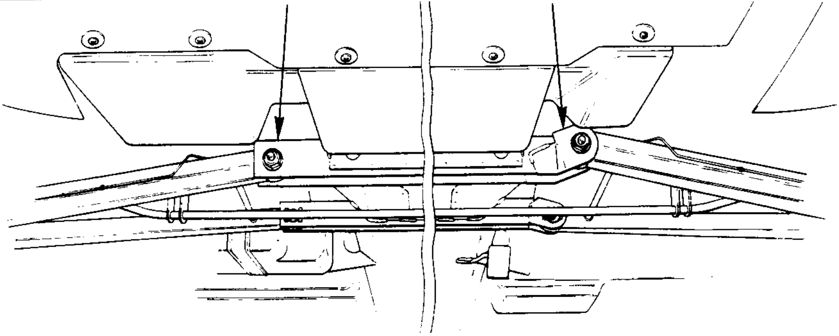
Change of Anti-lift Angle

The angle between the lower wishbone inboard pivot axis and the horizontal when viewed from the side, is referred to as the anti-lift angle. This was changed from 5° to 2½° for all USA models, and as a running change on other vehicles from VIN M 6644, **excluding** 6645, 6646, 6652, 6715, 6716, 6718, 6719, 6721, 6723, 6727, 6730, 6768, 6769, 6788.

It is most important to establish the type of chassis fitted before replacing any rear suspension components as the following parts are different for the two chassis variants:

- lower wishbone;
- top link inboard pivot stiffening strut;
- top link outboard pivot fixings;

If a chassis type is in doubt (e.g. service replacement chassis) examine the rear wishbone anchorage channel at the extreme rear of the chassis, and refer to the diagram below.



Early 5° type - straight channel

Later 2½° type - joggled channel

The 2½° type wishbone is identified by a blue paint mark on the upper surface of the wishbone front leg, and the 2½° stiffening strut by either a blue central band, or a white paint spot on its lower end. At the outboard end of the top link, the 2½° assembly uses an 80 mm long spigot sleeve running through the hub carrier and link bush, and a 9.5 mm spacer to maintain clearance between the roadspring and top link. See sectional diagrams.

Note the following points when re-assembling the suspension:

i) Copper Grease: Use a copper based grease on the shank of the lower wishbone outboard pivot stud to prevent corrosion, and aid subsequent disassembly. Ensure the threads are thoroughly de-greased before fitting the nyloc nuts.

ii) Pivot Bolts: Tighten the lower wishbone pivot bolts, top link pivot bolts, and damper to wishbone bolt, ONLY with the car at ride height, otherwise the bonded rubber bushes will be pre-loaded, resulting in degraded refinement, premature wear and incorrect ride height.

iii) Snubber Washers: Pay careful attention to the correct assembly of the snubber washers. Refer to the sectional diagrams.

iv) Top Link Outboard Pivot: Establish the lower wishbone anti-lift angle (see above) to ensure that the correct type of fixings are used at the outboard end of the top link. Refer to the sectional diagrams.

v) Top Link Inboard Pivot: Check that the reducing sleeve is fitted into the bush, and that spigot on the chassis spigots into the bush inner sleeve. Unless renewing the pivot bolt, **apply thread locking compound** to the thread, and fit through the stiffening strut and snubber washer before entering the bush and chassis.

vi) Anti-Roll Bar to Lower Wishbone: Fit and tighten the ball joint into the lower wishbone, before fitting the anti-roll bar onto the ball joint. Hold the squared end of the ball pin whilst tightening the nyloc nut.

vii) Geometry Check: After re-assembly, carry out a geometry check, and make any adjustments as necessary as detailed in DD.3.

viii) Brakes: Refit the brake caliper referring to section JE, and pump the brake pedal after re-assembly to restore pad position.

ix) Tighten all fixings to the specified torque loading.

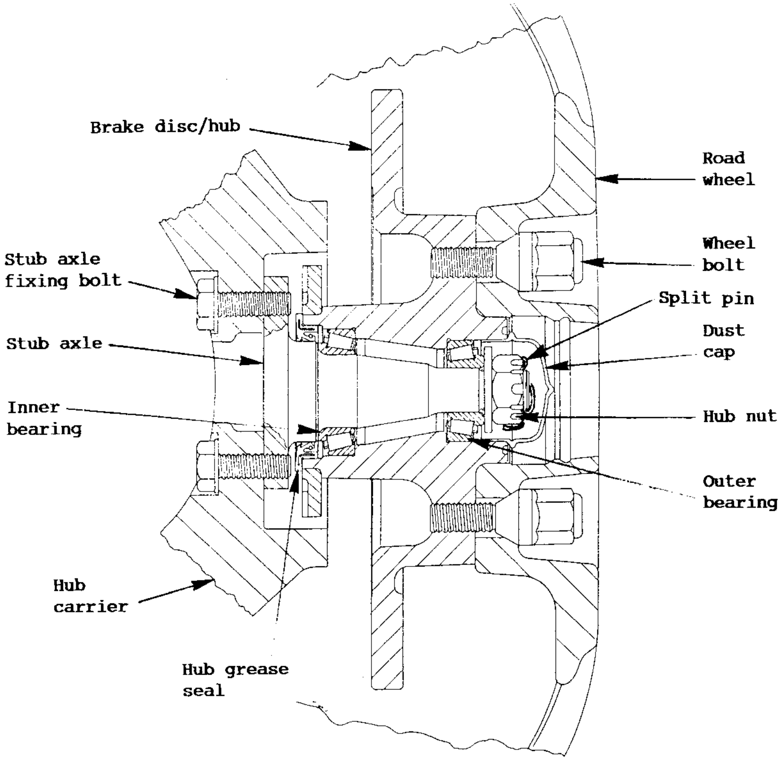
| Torque Settings | Nm | lbf.ft |
|---|---|---|
| 1. Damper top stem nut | 20 - 30 | 15 - 22 |
| 2. Spring top seat to chassis | 22 - 25 | 16 - 18 |
| 3. Damper to lower wishbone* | 68 - 72 | 50 - 53 |
| 4. Top link, outboard* and inboard** | 75 - 80 | 55 - 59 |

| Torque settings contd. | Nm | lbf.ft |
|---|---|---|
| 5. Top link camber adjustment bolts | 22 - 25 | 16 - 18 |
| 6. Lower wishbone inboard pivot (to chassis)* | 65 - 70 | 48 - 52 |
| 7. Lower wishbone outboard pivot (to hub carrier)* | 95 - 100 | 70 - 74 |
| 8. Anti-roll bar to wishbone ball joint | 36 - 40 | 27 - 30 |
| 9. Anti roll bar ball joints to lower wishbone | 36 - 40 | 27 - 30 |
| 10. Anti-roll bar drop links | 36 - 40 | 27 - 30 |
| 11. Hub nut | see DD.6 | |
| 12. Stub axle to hub carrier** | 60 - 65 | 44 - 48 |
| 13. Brake caliper bracket to hub carrier** | 35 - 39 | 26 - 29 |
| 14. Brake caliper to mounting bracket | 100 - 110 | 74 - 81 |

* Tighten only at ride height.
** Apply thread locking compound unless renewing bolts (pre-applied).

## DD.6 - HUB BEARINGS

Each rear hub is supported on two taper roller bearings, which are adjustable for endfloat:


Brake disc/hub
Road wheel
Stub axle fixing bolt
Wheel bolt
Split pin
Stub axle
Dust cap
Inner bearing
Hub nut
Outer bearing
Hub carrier
Hub grease seal

Adjustment

- Prise out the dust cap from the hub centre.
- Remove the split pin and tighten the hub nut to 25 Nm (18 lbf.ft) whilst rotating the wheel to settle the bearings.
- Slacken the nut, and re-tighten using fingers only.
- If necessary, tighten further, the smallest amount necessary to insert the split pin, bending the short end over the nut, and the long end over the end of the axle.
- Refit the hub dust cap.

Replacement

1. Brake Caliper: Release the two brake caliper mounting bolts, and support the caliper clear of the brake disc, without straining the flexible brake hose.

2. Brake Disc/Hub: Prise out the hub dust cap, pull out the split pin and remove the hub nut and washer. Withdraw the combined hub and brake disc.

3. Seal & Outer Races: Prise out the hub oil seal. Use a soft metal drift to knock out both the outboard bearing races from the hub. Cut outs are provided in the bearing recesses in the hub for this purpose.

4. Inner Race: Pull the inboard inner race from the stub axle using a suitable puller.

5. Stub Axle: If necessary, release the four bolts securing the stub axle to the hub carrier, and withdraw the axle.

6. Re-assembly: When re-fitting the stub axle, ensure that the contact surfaces of the stub axle flange and hub carrier, and the threads and clamping surfaces of the fixing bolts, are all scrupulously clean. Unless renewing the bolts, apply thread locking compound before fitting and torque tightening the four bolts (see torque list above).

7. Outer Races & Lubrication: Clean the bearing recesses in the hub before pressing the new races into position (correct way round!). Pack the new bearings with a lithium base wheel bearing grease, working into the roller cages. Coat the inside of the hub, outer races and dust cap with grease. Fit the inboard bearing rollers and inner race and retain in position by pressing in the new grease seal.

8. Hub Assembly: Fit the hub onto the axle, followed by the outboard inner race, washer and hub nut. Tighten the hub nut as detailed above, and fit the split pin and dust cap.

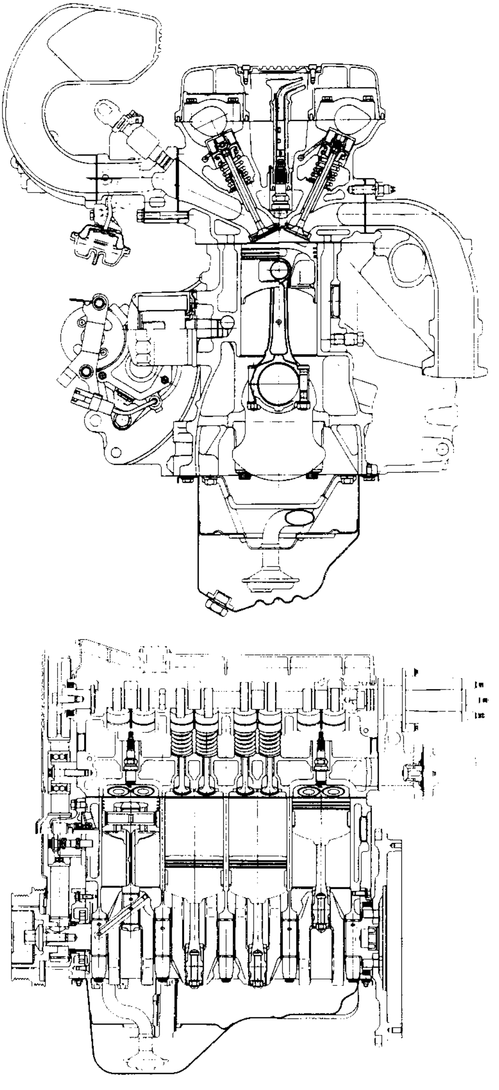
9. Brake Caliper: Refit the brake caliper, and torque tighten the two fixing bolts (see above). Pump the brake pedal to restore brake pad position.

10. Tighten all fixings to the specified torque loading.

# ENGINE

## SECTION EC - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description & Torque Charts | EC.1 | 3 |
| Lubrication System | EC.2 | 11 |
| Engine Maintenance Operations | EC.3 | 14 |
| Camshaft Drive Belt | EC.4 | 16 |
| Water Pump | EC.5 | 20 |
| Common Chamber, Fuel Injectors & Lower Manifold | EC.6 | 20 |
| Hydraulic Valve Lifters | EC.7 | 23 |
| Cylinder Head Assembly | EC.8 | 28 |
| Oil Sump | EC.9 | 37 |
| Oil Pump Assembly | EC.10 | 38 |
| Engine Removal/Replacement | EC.11 | 41 |
| Cylinder Block, Pistons & Connecting Rods | EC.12 | 44 |
| Crankshaft & Main Bearings | EC.13 | 52 |
| Turbocharger | EC.14 | 59 |
| Engine Mountings | EC.15 | 62 |
| Special Tools | EC.16 | 70 |



## EC.1 - GENERAL DESCRIPTION

**Note:** The terms 'front', 'rear', 'right' and 'left' when used in connection with a transversely mounted engine can cause some confusion. Throughout this manual, when one of these terms is used in conjunction with the word 'engine', the description relates to the orientation in which the engine is fitted. i.e. 'the left hand end of the engine' refers to the flywheel end. However, when referring to individual components of the engine, e.g. cylinder head, block, crankshaft etc., the terms are used in accordance with the motor industry norm. whereby the flywheel end of the engine is regarded as the rear. Thus the 'rear end of the crankshaft' is at the 'left hand end of the engine'.

The transversely mounted '4XE1' engine used in the Lotus M100 model in both naturally aspirated and turbocharged forms, is an in-line four cylinder twin overhead camshaft unit, fitted with four valves per cylinder and electronic multi-point fuel injection. For details of the fuel injection and engine management system refer to Service Notes Section EMJ/EMK/EML (separate publication).

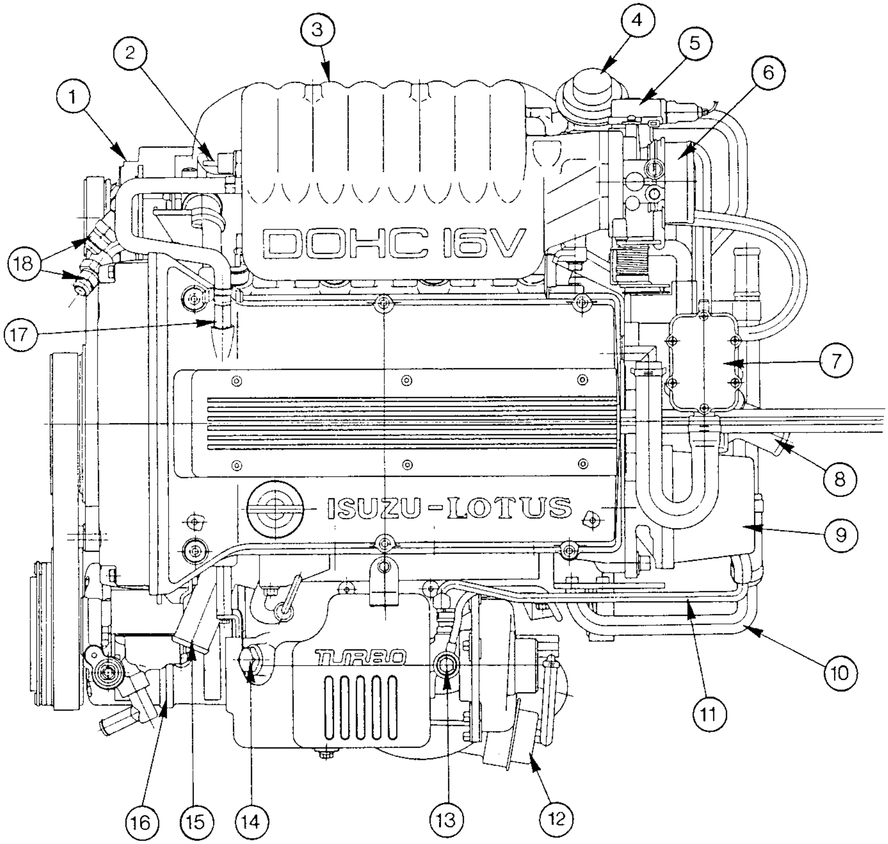
The cast iron cylinder block is surmounted by an aluminium alloy cylinder head containing four valves per cylinder in 'pent roof' combustion chambers. The inlet and exhaust valves are inclined at 50° to each other, and are operated by seperate overhead camshafts, driven from the front end of the crankshaft by a single toothed synthetic belt. The inverted bucket tappets incorporate hydraulic control of the valve clearances and eliminate the need for routine adjustment. The valves operate in replaceable cast iron valve guides and sintered steel valve seat inserts, and are fitted with single helical springs.

Forged aluminium alloy solid skirt pistons, are fitted with two compression and one oil control ring, all above the gudgeon pin. Two methods of gudgeon pin retention are used. On N.A. engines, the pin is an interference fit into the little end of the forged steel I-section connecting rod, whereas Turbo engines use a fully floating gudgeon pin retained by circlips in the piston. The five bearing cast iron crankshaft is tuftrided for wear resistance, and is controlled for end-float by thrust washers either side of no.2 main bearing. A trochoid type oil pump driven directly by the front end of the crankshaft, draws from an oil supply stored in the pressed steel sump.

A centrifugal water pump mounted on the front face of the block, is driven by the toothed cam belt, and the ignition distributor (N.A.) or cam angle sensor (Turbo) is driven off the rear end of the exhaust camshaft.

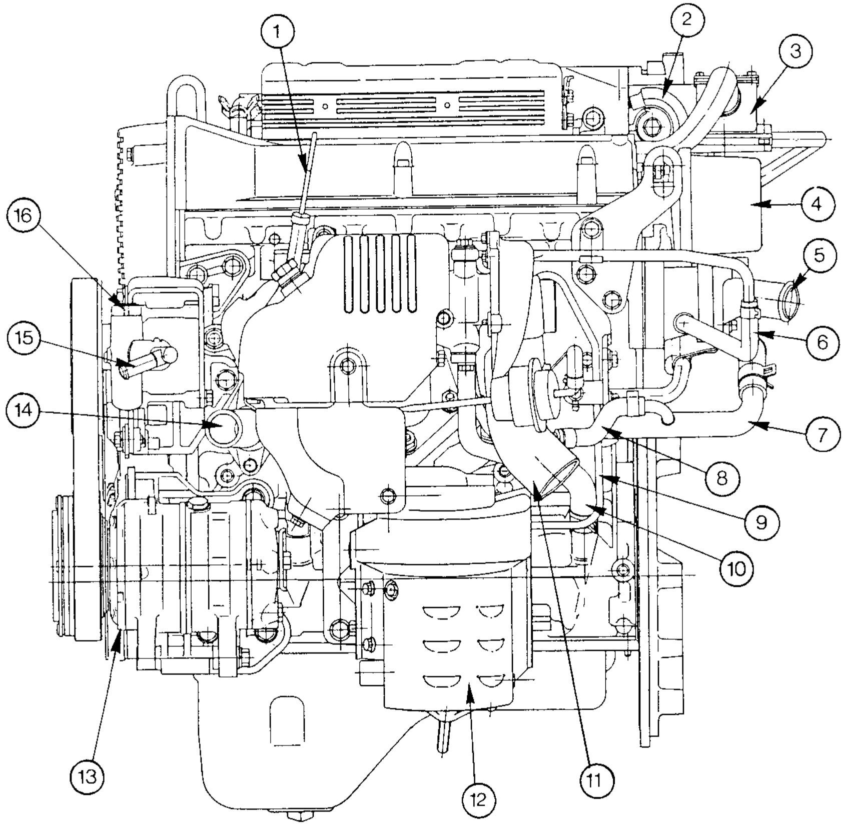
The intake system incorporates a water heated throttle body containing a primary throttle valve; a plenum chamber integral with eight individual intake tracts; and a lower intake manifold feeding the four bifurcated cylinder head ports. The lower intake manifold contains a fuel injector for each of the four ports and a secondary throttle valve controlling one of the two tracts for each cylinder. These secondary throttle valves are operated by a single vacuum actuator whose vacuum supply is controlled by the engine management computor. At engine speeds below 5,200 rpm, the secondary throttles are closed to maintain a high gas speed in the intake air column for optimum low speed driveability and idle quality, but at higher engine speeds the secondary throttles are opened for maximum volumetric efficiency and performance.

## 4XE1-MT TURBO ENGINE PLAN VIEW



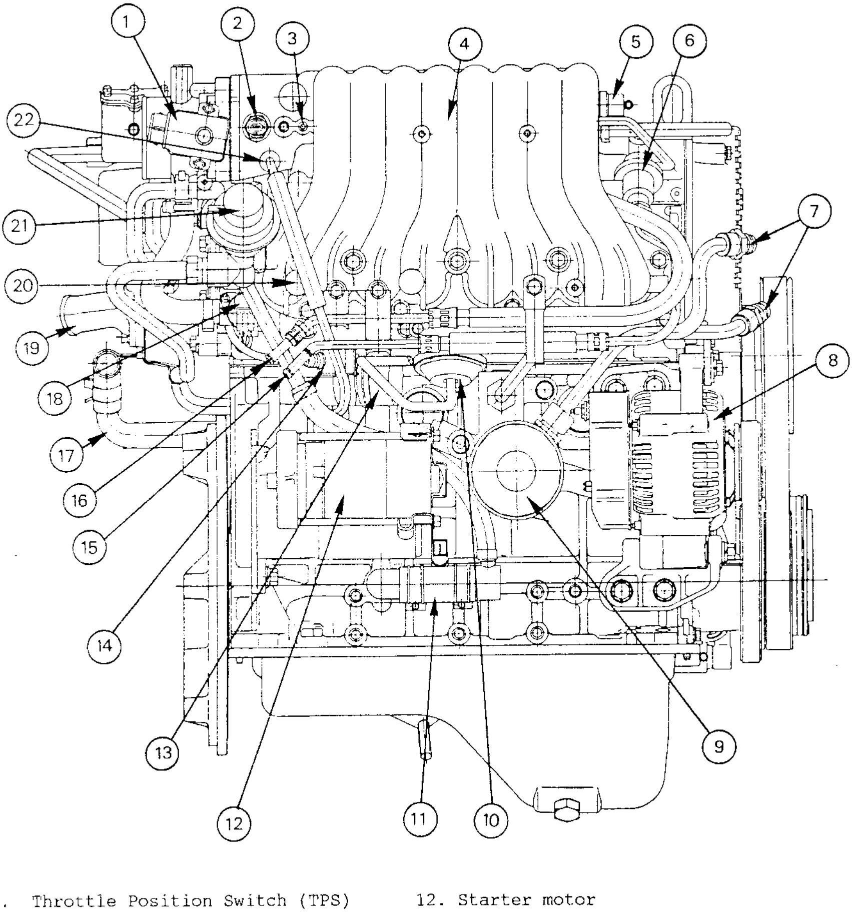
1. Alternator
2. MAP sensor filter/damper
3. Common chamber (intake plenum)
4. Exhaust Gas Recirculation (EGR) valve
5. Throttle Position Switch (TPS)
6. Primary throttle body
7. Oil seperator (Turbo only)
8. Thermostat housing outlet
9. Cam angle sensor (distributor on N.A.)
10. Radiator by-pass water pipe
11. Turbo water feed pipe
12. Wastegate capsule
13. Turbo oil feed
14. Oxygen sensor blanking plug
15. Water pump inlet spout
16. Air conditioning compressor
17. Positive Crankcase Ventilation (PCV) valve
18. Oil cooler hose connections

## 4XE1-MT TURBO ENGINE FRONT SIDE



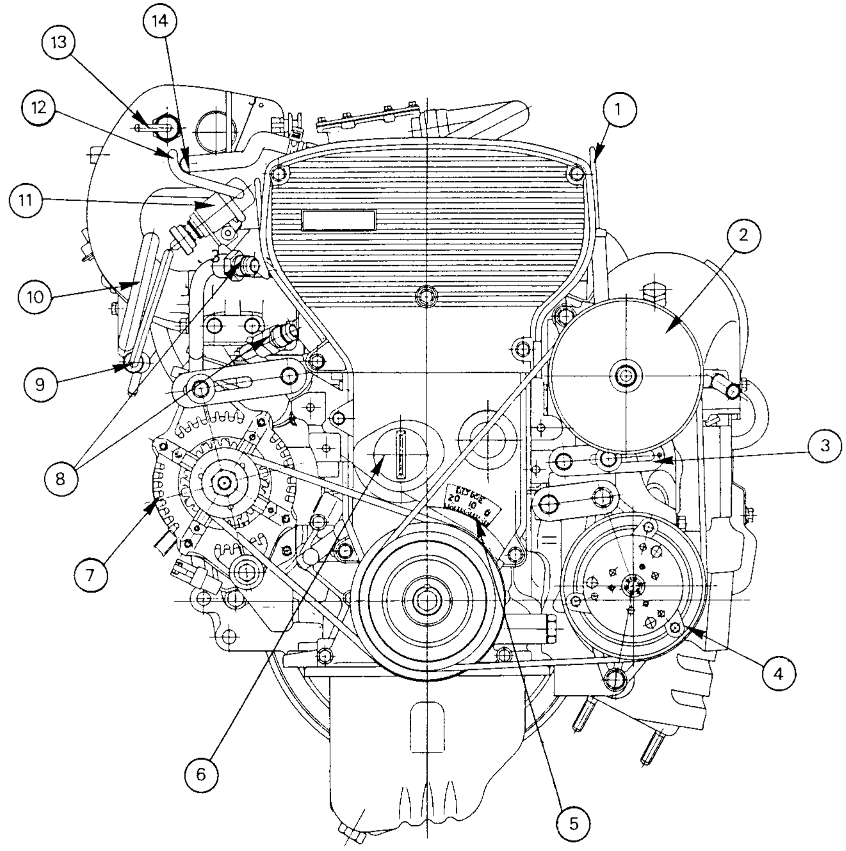
1. Dipstick
2. Primary throttle quadrant
3. Oil seperator (Turbo only)
4. Cam angle sensor (distributor on N.A.)
5. Thermostat housing outlet
6. Turbo water feed hose
7. Radiator by-pass water pipe
8. Turbo water return hose
9. Turbo oil feed pipe
10. Turbo oil drain hose
11. Turbo compressor outlet
12. Starter catalyst housing (Turbo only)
13. Air conditioning compressor
14. Water pump inlet spout
15. PAS pump inlet connection
16. PAS pump outlet connection

## 4XE1-MT TURBO ENGINE REAR SIDE



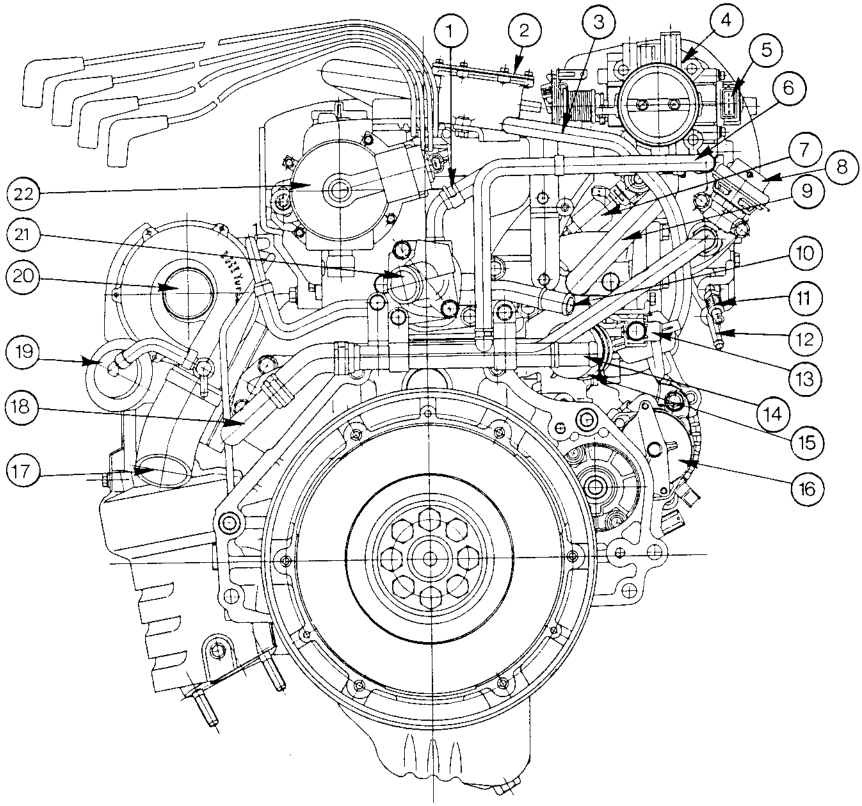
1. Throttle Position Switch (TPS)
2. Manifold Air Temperature (MAT) sensor
3. Evaporative emissions connection
4. Common chamber (intake plenum)
5. MAP sensor filter/damper
6. Fuel pressure regulator
7. Oil cooler hose connections
8. Alternator
9. Oil filter
10. Secondary throttle vacuum actuator
11. Oil seperator drain hose
12. Starter motor
13. Secondary throttle vac. reservoir
14. Secondary throttle vac. sol. valve
15. Fuel return connection
16. Fuel feed connection
17. Radiator by-pass water pipe
18. Idle Air Control (IAC) valve
19. Thermostat housing outlet
20. Brake servo vacuum take off
21. Exhaust Gas Recirculation (EGR) valve
22. Secondary throttle vacuum take-off

## 4XE1-MT TURBO ENGINE RIGHT HAND END



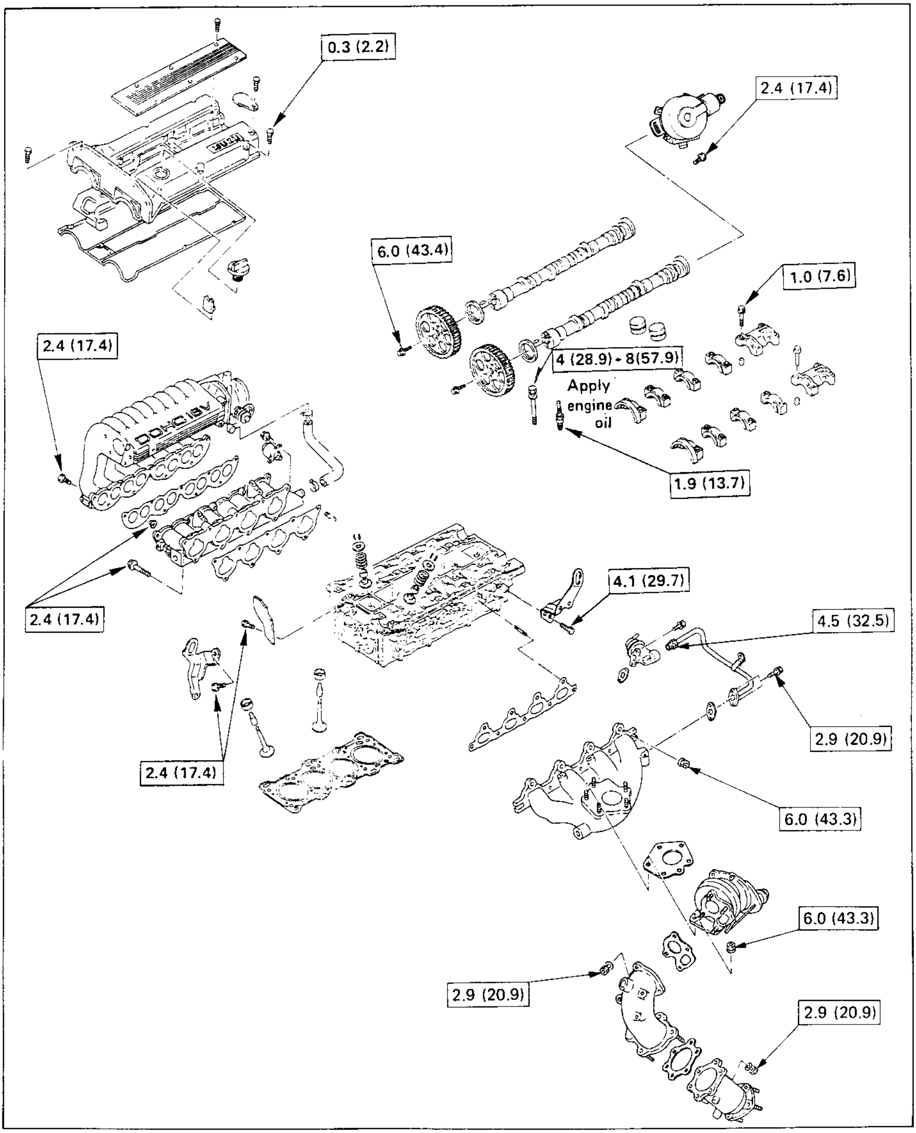
1. Dipstick
2. PAS pump pulley
3. PAS pump adjuster strap
4. A.C. compressor clutch
5. Timing marks
6. Cam belt tensioner access grommet
7. Alternator
8. Oil cooler feed and return connections
9. Fuel return pipe
10. Fuel feed hose
11. Fuel pressure regulator valve
12. Regulator valve pressure take-off
13. MAP sensor filter/damper
14. PCV valve plenum connection

## 4XE1-MT TURBO ENGINE LEFT HAND END

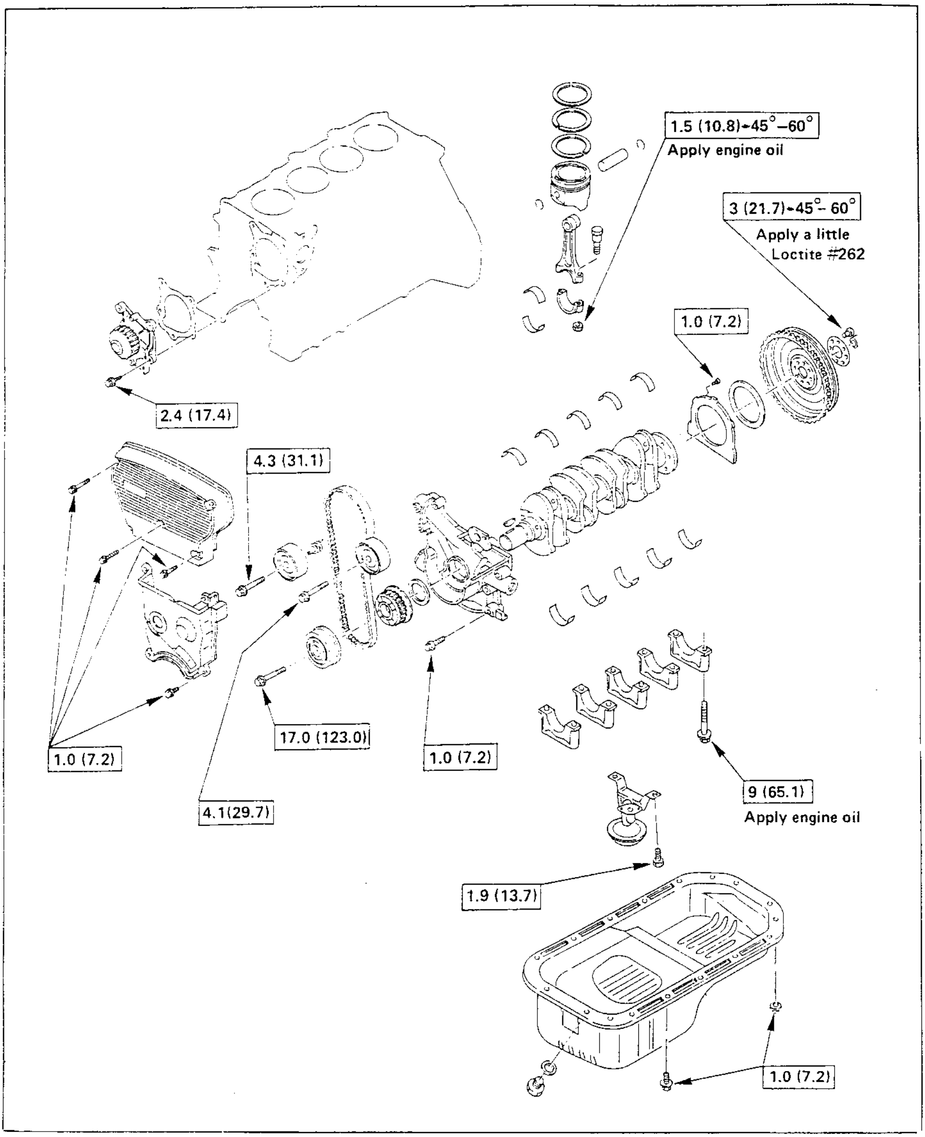


1. Throttle body water feed
2. Oil seperator (Turbo only)
3. Oil drain hose
4. Primary throttle body
5. Throttle Postion Switch (TPS)
6. Throttle body water return
7. Fuel injector
8. Exhaust Gas Recirculation (EGR) valve
9. Idle Air Control (IAC) hose
10. Heater feed connection
11. Fuel feed connection
12. Fuel return connection
13. Secondary throttle VSV
14. Heater return connection
15. Secondary throttle vacuum reservoir
16. Starter motor
17. Turbo compressor outlet
18. Radiator by-pass water pipe
19. Wastegate capsule
20. Turbo compressor inlet
21. Thermostat housing outlet
22. Cam angle sensor (distributor on N.A.)

**Fixings Torque Summary** **kgf.m (lbf.ft)**


0.3 (2.2)
2.4 (17.4)
6.0 (43.4)
1.0 (7.6)
2.4 (17.4)
4 (28.9) - 8(57.9)
Apply engine oil
DOHC 16V
1.9 (13.7)
2.4 (17.4)
4.1 (29.7)
4.5 (32.5)
2.9 (20.9)
2.4 (17.4)
6.0 (43.3)
6.0 (43.3)
2.9 (20.9)
2.9 (20.9)

**Fixings Torque Summary** **kgf.m (lbf.ft)**


1.5 (10.8)-45°–60°
Apply engine oil
3 (21.7)-45°- 60°
Apply a little Loctite #262
1.0 (7.2)
2.4 (17.4)
4.3 (31.1)
17.0 (123.0)
1.0 (7.2)
1.0 (7.2)
4.1(29.7)
9 (65.1)
Apply engine oil
1.9 (13.7)
1.0 (7.2)

## EC.2 - LUBRICATION SYSTEM

The wet sump lubrication system uses a trochoidal rotor and annulus type pump mounted on the front face of the cylinder block, driven directly by the crankshaft. Oil is stored in a pressed steel sump, and is drawn through a gauze strainer and pick up pipe into the inlet side of the oil pump. At the outlet side of the pump, a spring plunger type pressure relief valve bleeds off excessive pressure back into the sump. The pressurised oil is directed via drillings in the block, to a full flow canister type filter mounted on the right hand side of the block. Before flowing through the filter, a sandwich plate fitted between the filter and block diverts all the oil flow via flexible hoses to an oil cooler mounted at the right hand front of the vehicle. Being horizontally mounted, the filter incorporates an anti-flowback valve to prevent all the oil draining from the filter when the engine is stopped. A safety overflow valve is also fitted, which provides a by-pass around the filter should the filter become blocked or restricted.

An oil gallery along the right hand side of the block, receives oil from the filter and distributes it via five drillings to each of the main bearings. Crank journals 1,2 4 & 5 are provided with drillings through to their adjacent crankpins for big end lubrication, and are also drilled diametrically across the journal. These journals are fitted with upper main bearing shells having a hole, to admit the oil supply from the block drilling, and a groove which acts as an oil supply channel to one end of the journal cross drilling, in order to maintain a continuous oil supply to the big end bearing. Lower main bearing shells are plain. On Turbo engines, main bearings 1,2,3 & 5 also supply a feed to oil jets designed to spray the underside of the piston crowns in order to aid piston cooling and cylinder lubrication. A drilling towards the right hand end of the oil gallery, carries oil upwards through the block and into the cylinder head, where a check valve prevents all the oil draining off when the engine is stopped, and a pressure relief valve prevents excessive oil pressure reaching the valve gear. Oil galleries running alongside each camshaft, supply the camshaft journals and lobes, and the hydraulic tappets and valve stems.

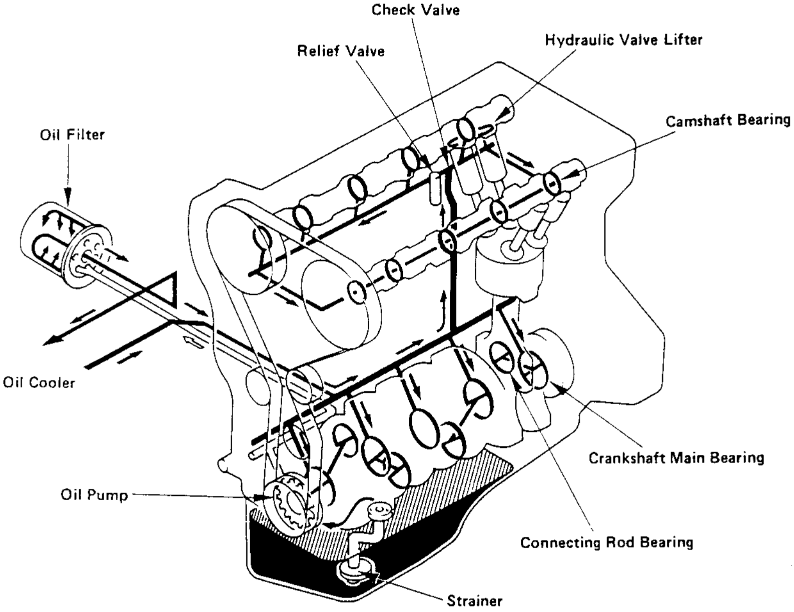
The oil feed for the turbocharger is taken from the crankcase oil gallery, and is returned to the left hand front of the block.

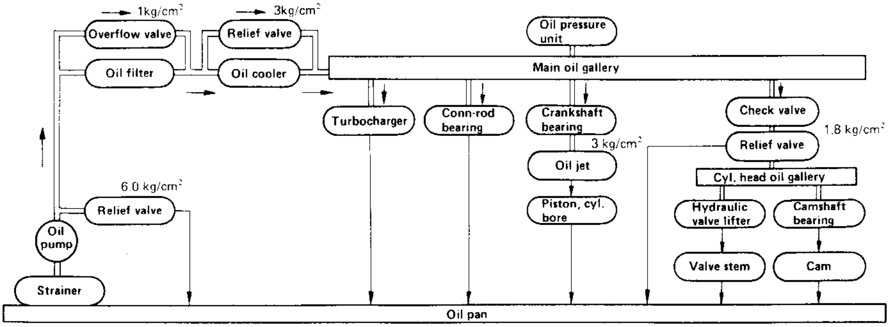
Precautions

i) Use only those lubricants listed in section 'O' for the ambient temperature range pertaining.
ii) When rebuilding an engine, use copious amounts of recommended lubricant to ensure adequate lubrication on initial start up.
iii) After rebuild, the engine should be cranked with the ignition disconnected until oil pressure is registered on the gauge.

In the event of engine failure involving the possibility of debris entering the lubrication system, it is essential that the following precautions are taken before re-assembly:

a) Clean and inspect all engine oilways in block, crankshaft, cylinder head etc.
b) Clean and inspect oil pump, pick up pipe and strainer, and all pressure relief valves.
c) Thoroughly flush out oil cooler hoses.
d) In view of the difficulty of ensuring no debris is retained in the oil cooler, this item should always be replaced in such circumstances.


Check Valve
Relief Valve
Hydraulic Valve Lifter
Camshaft Bearing
Oil Filter
Oil Cooler
Crankshaft Main Bearing
Oil Pump
Connecting Rod Bearing
Strainer


1kg/cm²
3kg/cm²
Overflow valve
Relief valve
Oil pressure unit
Oil filter
Oil cooler
Main oil gallery
Turbocharger
Conn-rod bearing
Crankshaft bearing
3 kg/cm²
Oil jet
Piston, cyl. bore
Check valve
1.8 kg/cm²
Relief valve
Cyl. head oil gallery
Hydraulic valve lifter
Camshaft bearing
Valve stem
Cam
6.0 kg/cm²
Relief valve
Oil pump
Strainer
Oil pan

Oil Level Checking

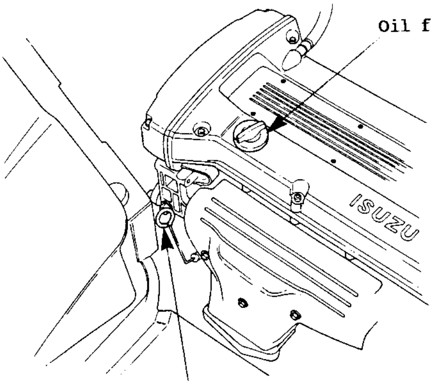
Ensure that the car is parked on a level surface and that at least one minute has elapsed since stopping the engine to allow oil to drain into the sump before withdrawing the dipstick located at the right hand front of the engine. Wipe the dipstick with a non-fluffy cloth, replace, pressing firmly, and withdraw again to inspect the oil level. The correct level is to the upper mark on the dipstick.

The oil capacity and difference between high and low dipstick marks are listed in section TDH. Top up if necessary via the filler on the camshaft cover, using a recommended lubricant, but do NOT overfill. Refit the filler cap securely.

Oil Changing Procedure

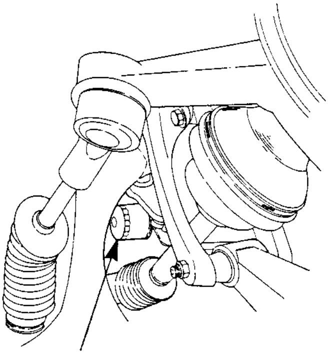
The oil should be renewed, and a new oil filter fitted at intervals specified in the Maintenance Schedule - see section O.

The sump plug is located at the right hand side of the sump, and should be removed to drain the sump immediately after a run when the oil is warm and the impurities are held in suspension. Allow to drain thoroughly, clean the drain plug, replace the sealing washer if necessary, and refit securely. Renew the oil filter (see below), and fill with a recommended lubricant to the top mark on the dipstick. Run the engine briefly, and recheck level.



**Oil filler cap**

**Dipstick**



**Oil filter viewed from beneath RHF suspension**

Oil Filter

The oil filter should be renewed at intervals specified in the Maintenance Schedule - see section O.

The oil filter is horizontally mounted at the right hand side of the block, and is of the disposable canister type. Access to the filter is most easily achieved from beneath with the vehicle raised on a 'wheel free' lift. To remove, turn in a counter-clockwise direction using an oil filter wrench (T000T1020) if necessary. Discard the filter after removal.

Before fitting a new filter, clean the mating faces on both the new filter and the oil cooler adaptor and smear both faces with clean oil. Add a small amount of clean oil into the filter and screw on by hand sufficiently to make a firm seal, usually 2/3 to 3/4 of a turn after the faces have made contact. Start the engine and check for oil leaks, tightening the filter further if necessary. Stop engine and recheck oil level.

## EC.3 - ENGINE MAINTENANCE OPERATIONS

This section gives guidance on engine maintenance operations specified in the Maintenance Schedule.

1. Renew engine oil. See section EC.2.

2. Renew engine oil filter. See section EC.2.

3. Air cleaner element. The folded paper type air cleaner element is housed in a cylindrical box at the left hand front of the engine bay. Air is drawn from ahead of the left hand front wheelarch into the centre of the filter element, before passing through the filter and into the air induction hose to the intake plenum (N/A), or turbocharger compressor (Turbo). When the vehicle is operated in a reletively dust free environment, the paper element should be renewed at intervals specified in the maintenance schedule, but where a dusty or smog laden atmosphere is prevalent, more frequent replacement will be required, dependent on the level of pollution. The condition of the filter element should be examined at every service.

If the lid of the air filter housing is to be removed, it is most important to take precautions to prevent dirt and grit from the 'dirty' side of the cleaner element passing to the clean side:
- Disconnect the outlet hose from the air cleaner housing before releasing the four over-centre clips securing the housing lid.
- Remove the lid and withdraw the filter element to examine for damage and cleanliness.
- Thoroughly clean out the inside of the filter housing before fitting the element, ensuring that it is correctly seated.
- Refit the housing lid and connect the outlet hose.

4. Check coolant level and anti-freeze concentration; Renew coolant; Check cooling system hoses and connections; Inspect radiator, oil cooler, chargecooler and pipework for damage or leaks. See section KD.

5. Renew spark plugs. The spark plugs should be renewed at intervals specified in the Maintenance Schedule.
- Remove the 6 screws securing the spark plug well cover, and remove the cover.
- Pull off the spark plug leads from the plugs.
- Before removing the spark plugs, use an airline to blow any dirt from around the plug seats.
- Unscrew each spark plug and take care that no debris falls into the cylinder through the open plug hole.
- Check the electrode gap (see 'Technical Data' section TDG) of the new spark plugs before fitting, and tightening.
- Refit the numbered plug leads (no.1 at RH end of engine) and plug well cover.

6. Replace timing belt. See section EC.4.

7. Check auxiliary drive belt condition and tension. At intervals specified in the Maintenance Schedule, carefully inspect the whole length of the alternator belt and PAS pump/a.c. compressor belt (if fitted), for any signs of fretting, cracking, perishing or any other deterioration. Renew the belt if in any doubt.
Alternator: Tension = 41 ± 9 kg (90 ± 20 lb) using a Burroughs gauge.

If necessary, slacken the alternator pivot bolt, and the two strap bolts and move the alternator to achieve the correct belt tension. Tighten the bolts and re-check the tension.

PAS pump/a.c. compressor: Tension = 65 ± 7 kg (145 ± 15 lb) using a Burroughs gauge.

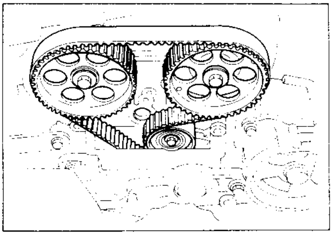
If necessary, slacken the pivot bolt securing the PAS pump mounting bracket to the engine, and the two bolts securing the adjuster strap. Swing the pump bracket to achieve the specified tension, and tighten the three bolts to 18 Nm (13 lbf.ft).

9. Check CO level (cars without catalyst): See section EMK/EML

10. Inspect condition & security of engine mountings: Carefully examine the RH and LH engine mounting rubbers for any signs of swelling, splitting, cracking, or other signs of deterioration. Replace if necessary.

11. Check security of engine ancillaries: Check alternator, PAS pump, compressor, and other engine mounted ancillaries for security.

## EC.4 - CAMSHAFT DRIVE BELT



### Tensioning

Cam belt tension should be measured only with the engine fully **cold**:

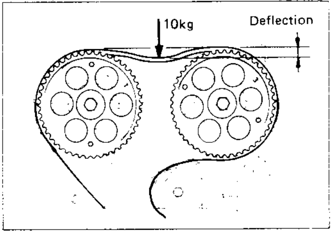
1. Remove Top Belt Cover: Remove the five screws securing the top belt cover and ease the cover past the engine mounting bracket.

2. Measure Tension: i) Turn the engine to TDC, using the crankshaft front pulley reference marks, and then turn further in the normal direction of rotation (clockwise as viewed from the right hand side of the car) to a position 60° after TDC.

ii) Apply a load of 10 kg (firm finger pressure) to the belt between the two cam pulleys, and measure the deflection.

Belt deflection at 10 kg.

| New Belt | Used Belt |
|---|---|
| 7 - 8.5 mm | 9 - 10.5 mm |



If belt tension is outside specification, it is necessary to remove the right hand engine mounting crossbeam in order to gain sufficient access to the belt tensioner:

3. Remove Right Hand Engine Mounting: Support the right hand side of the engine, to relieve any load from the right hand engine mount. Remove the bolt securing the engine bracket to the right hand engine mounting rubber. Remove the four socket head bolts securing the aluminium engine mounting crossbeam to the two engine brackets, and remove the crossbeam. If necessary, disconnect the lower oil cooler pipe connection, and the PAS high pressure hose.

4. Tension Belt: Turn the engine to TDC. Remove the tensioner bolt access grommet from the belt lower cover, and use a spline socket wrench to slacken the tensioner bolt. This allows the tensioner spring to apply tension to the belt. Torque tighten the tensioner bolt to 42 Nm (31 lbf.ft).
Check the belt tension as above (Note - turn the engine to 60° ATDC).
For a used belt, the spring tension alone should be sufficient to meet the tension specification. For a new belt, a higher tension is called for, and it is necessary to provide additional tension whilst the pulley clamp bolt is tightened. A hexagonal socket is provided in the pulley hub for this purpose. Use an allen key wrench in this socket to manually apply additional tension as required by turning counterclockwise. The socket may also be used to prevent the hub from turning whilst the clamp bolt is tightened.

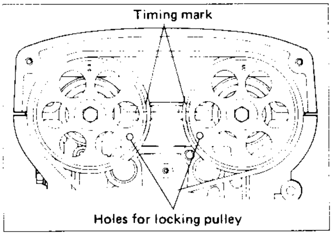
5. Re-assemble: Refit the grommet, engine mounting and cam belt top cover.

Removal

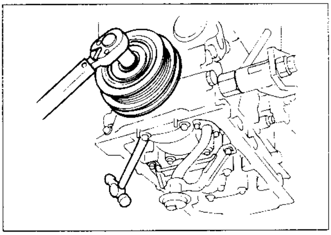
The camshaft drive belt may be removed with the engine 'in situ', but in order to remove the cambelt lower cover, it is necessary to support the engine, and remove the right hand engine mounting.

1. Remove Auxiliary Drive Belts: Slacken the power steering pump and alternator belts, and remove both belts from the pulleys.

2. Timing Position: Before removing the pulley, first remove the cambelt upper cover, and turn the engine to the timing position, with the crank pulley aligned with the TDC mark, and the timing marks on the two camshaft pulleys facing each other as shown.



3. Crankshaft Pulley: Remove the bolt securing the crankshaft auxiliary belt pulley and withdraw the pulley.



4. Remove Right Hand Engine Mounting: Support the right hand side of the engine, to relieve any load from the right hand engine mount. Remove the bolt securing the engine bracket to the right hand engine mounting rubber. Remove the four socket head bolts securing the aluminium engine mounting crossbeam to the two engine brackets, and remove the crossbeam.

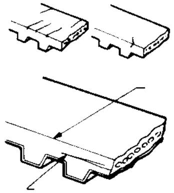
5. Lower Belt Guard: Remove the screws securing the lower belt guard, and remove the guard.

6. Remove Cam Belt: Use a spline socket wrench to loosen the tensioner pulley clamp bolt, and rotate the pulley clockwise to slacken the belt. Slide the belt off the pulleys.

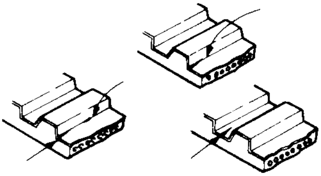
**Precautions**

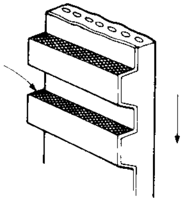
- Do not attempt to pry or stretch the belt with a screwdriver or any other tool during removal or replacement;
- Do not force the belt to bend or twist excessively, or damage may be caused to the belt core;
- Do not allow oil or any other chemical substances to come into contact with the belt, or belt life will be shortened;
- Store cam drive belts in a cool dark place. Do not expose to heat or direct sunlight;
- Do not rotate the crankshaft or camshafts with the drive belt removed, or damage may be caused to the valves and pistons.

7. Inspect Cam Belt: i) Carefully inspect the belt for cracks in the sides or on the smooth back face. Replace the belt if any such signs are found.



ii) Carefully inspect the toothed side of the belt for signs of cracking, deterioration of the fabric, or abnormal or excessive wear. Replace the belt if any such signs are found.

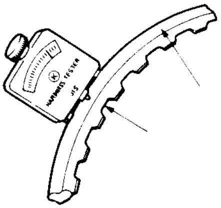




iii) Check the rubber hardness of the belt at five points around the circumference.

Rubber hardness limit (HS) = 90

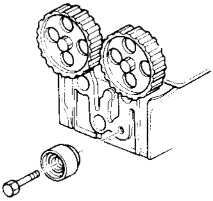
Replace the belt if a even a single measurement is outside specification.



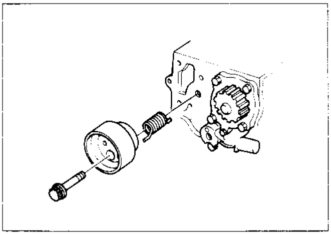
Replacement

1. Idle Pulley: If necessary, refit the cam belt idle pulley, and torque tighten the fixing bolt.

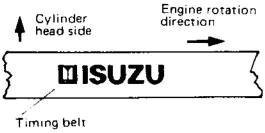
Torque = 40 Nm (30 lbf.ft)



2. Tensioner: If necessary, refit the cam belt tensioner eccentric hub/pulley and spring.
Fit the short end of the spring into its hole in the block, and the longer end into the pulley hub. Turn the hub clockwise to tension the spring, and tighten the bolt to hold in position.

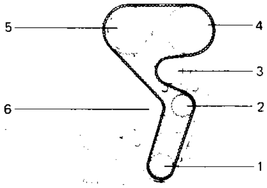


3. Cam Belt: i) Check that the crankshaft and camshafts are still in the correct timing position. The construction of the belt is directional; arrange the belt so that the lettering may be read when viewed from the right hand end of the engine.



ii) Slide the belt over the pulleys, as shown in the diagram, and centralise the belt on each pulley.

- 1: crankshaft
- 2: water pump
- 3: idler
- 4: exhaust camshaft
- 5: inlet camshaft
- 6: tensioner



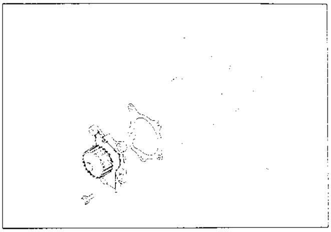
4. Tension Belt: Check that the engine timing marks are still aligned (i.e. the shafts have not been disturbed during belt fitting) before turning the engine two revolutions in the normal direction to settle the belt. Tension the belt as detailed at the start of EC.4.

5. Re-assemble: Refit the following parts;

- belt upper & lower cover; 10 Nm (7 lbf.ft)
- lower cover grommet
- crankshaft pulley; 170 Nm (123 lbf.ft)
- engine mounting crossbeam

## EC.5 - WATER PUMP

The water pump is mounted on the front face of the cylinder block, and is driven by the camshaft drive belt.
To remove the pump, drain the cooling system and follow the procedure in section EC.4 to remove the cam drive belt. The water pump fixings may then be released, and the pump removed from the engine.



The water pump is a non-servicable sealed unit, and if any of the following faults should occur, the complete unit must be replaced:

- cracks in the pump body;
- water leakage from the shaft seal;
- free play or abnormal noise in the bearing;
- cracks or corrosion in the impellor;
- cracks or wear in the pulley

When refitting the water pump, use a new gasket and torque tighten the fixing bolts to 24 Nm (17 lbf.ft). Refer to section EC.4 to refit the camshaft drive belt, and to section KD to refill the cooling system.

## EC.6 - COMMON CHAMBER, FUEL INJECTORS & LOWER MANIFOLD

### Common Chamber - Removal

The common chamber comprises an intake plenum chamber receiving air through the throttle body, and eight intake tracts feeding into the lower manifold.

1. R.H. End of Common Chamber: From the right hand end of the common chamber, disconnect the following:

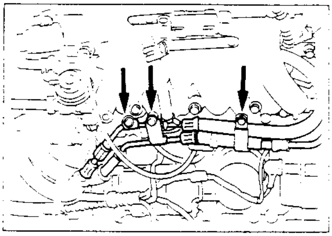
- pressure hose to the fuel pressure regulating valve;
- pressure hose to the MAP sensor;
- breather hose to the positive crankcase ventilation valve;
- engine hanger bracket;
- earth leads.

2. Throttle Valve Body: Disconnect the throttle cable from the quadrant, and release the four bolts securing the throttle body to the common chamber. Pull the throttle body away, leaving hoses etc. attached.

3. L.H. End of Common Chamber: From the left hand end of the common chamber, disconnect the following:

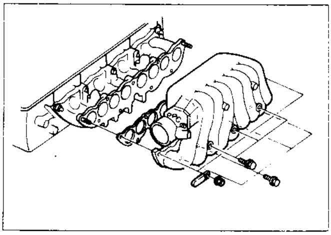
- secondary throttle valve vacuum hose (beneath MAT sensor);
- evap. canister vacuum hose (if fitted);
- vacuum hose from E.G.R. capsule, and E.G.R. pipe from valve;
- brake servo vacuum hose from no.8 intake tract;
- M.A.T. sensor electrical connector;
- throttle cable from its abutment;
- common chamber mounting bracket.

4. Fuel Pipe Clips: Release the three fuel line clips from the common chamber at the back of the engine.



5. Common Chamber: Release the fixings securing the common chamber to the lower manifold:

- one nut at each end;
- four bolts along lower edge;
- three bolts along upper edge.



## Fuel Rail & Injectors - Removal

**WARNING:** Fuel pressure remains in the system after switching off the ignition. Before servicing an injector, fuel rail or pressure regulator, it is necessary first to safely relieve the pressure. See 'Fuel Pressure Relief Procedure'.

FUEL PRESSURE RELIEF PROCEDURE
- Trip the inertia switch (in battery compartment) to disconnect the fuel pump feed, and start the engine.
- After the engine stops from fuel starvation, crank the engine for at least 5 seconds to dissipate any remaining fuel pressure.
- Fuel connections are now safe for servicing.

**CAUTION:** Take great care when removing the fuel rail and injectors, to avoid damage to the electrical connector pins or injector spray nozzles. Before removing the fuel rail assembly, it is recommended to use an engine cleaner such as AC Delco X-30A to help prevent dirt ingress. Cap or plug all fittings as soon as possible after opening.

1. Fuel Inlet: Using a back up wrench to prevent the fuel rail inlet connector from turning, release the fuel inlet pipe from the left hand end of the rail. Use a shop towel to absorb any escaping fuel.

2. Fuel Outlet: Using a back up wrench to prevent the fuel rail outlet connector from turning, release the fuel outlet pipe from the right hand end of the rail. Use a shop towel to absorb any escaping fuel.

3. Fuel Rail: Unplug the electrical connector from each injector using a 14mm open ended spanner. Remove the two bolts securing the fuel rail to the lower manifold, and carefully withdraw the rail complete with injectors to a clean bench.

4. Injectors: Remove each injector from the fuel rail by spreading the open end of the clip to enable it to be removed and discarded. Withdraw the fuel injector from the rail.

Note: Each injector is serviced only as a complete assembly, and since it is an electrical component, must not be immersed in any cleanser.

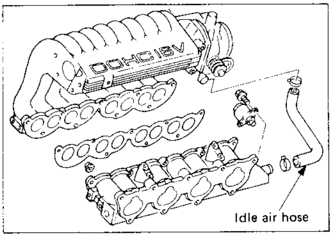
For further information on servicing and testing of the fuel rail assembly, including the pressure regulating valve, see section EMJ/EMK/EML (engine management; seperate publication).

Lower Intake Manifold - Removal/Repacement

To remove the lower manifold, disconnect the following:

- injector harness retainer;
- idle air control valve electrical connector;
- idle air hose from L.H. end of manifold;
- secondary throttle solenoid valve electrical connector;
- oil cooler pipes support bracket from R.H. end of manifold.

Remove the nine fixings securing the manifold to the cylinder head, and remove the manifold.



Reverse this procedure to re-fit, torque tightening the bolts to 24 Nm (17 lbf.ft).

Fuel Rail & Injectors - Replacement

1. Injectors: Fit new 'O' rings to the top and bottom of each injector, and lubricate with clean engine oil. Fit new injector retainer clips to each injector and push each injector into the fuel rail far enough to engage both legs of the retaining clip on the fuel rail ribs. Position the injectors with the electrical socket uppermost.

2. Fuel Rail Assembly: Carefully fit the fuel rail and injectors to the engine, pushing the injectors into the inlet manifold bores until the bolt holes on the rail and manifold are aligned. Tighten the two fixing bolts.

3. Connections: Renew the fuel rail inlet connection 'O' ring and lubricate with engine oil. Fit the fuel feed line and use a back up wrench to prevent the inlet connection turning whilst torque tightening to 30 Nm (22 lbf.ft). Fit the fuel return pipe to the pressure regulator valve, and fit the electrical connector to each injector.

Common Chamber - Replacement

Reverse the removal procedure, noting the following torque settings:

- common chamber to lower manifold; 24 Nm (17 lbf.ft)
- throttle body to common chamber; 24 Nm (17 lbf.ft)

## EC.7 - HYDRAULIC VALVE LIFTERS

### Description of Operation

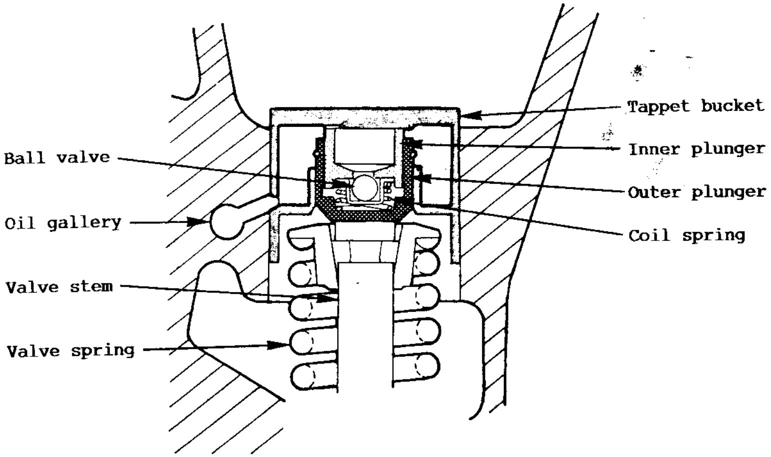
The hydraulic valve lifters (HVL) fitted on the 4XE1 engine, use the pressurised engine oil supply to control valve clearance and eliminate the necessity for periodic checking, and adjustment of tappet shimming.

The HVL consists of three main components; a tappet bucket, a two part (telescopic) plunger, and a ball valve. The plunger assembly slides inside the tappet bucket, with the inner and outer plungers held apart (extended) by a coil spring. In operation, with the engine valve closed, pressurised oil from an oil gallery running alongside the valves, is fed into the inside of the tappet bucket, and into the inner plunger. The oil flows past the ball valve, and enters the lower chamber where it extends the plunger assembly and takes up any clearance between the valve stem and the heel of the cam. When the cam lobe starts to depress the tappet bucket, and compress the plunger assembly, pressure in the lower chamber rapidly rises above supplied oil pressure so that the ball valve is forced against its seat in the inner plunger. The trapped incompressible fluid in the lower chamber acts to transfer the movement of the tappet bucket to the engine valve stem.

When the engine valve is returned to its seat, the compression force on the plunger assembly is relieved, and pressure in the lower chamber is reduced to that of the oil supply. Oil is again able to flow past the ball valve into the lower chamber to keep the plunger assembly fully extended and the tappet against the heel of the cam.

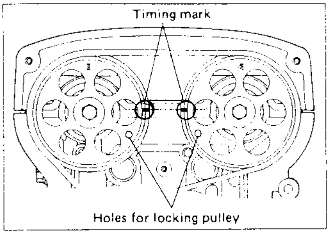
The purpose of the coil spring is to maintain full plunger extension when the engine is stopped and oil pressure is absent. The lower chamber thus remains filled with oil, and the tappet assembly operates satisfactorily for the short period before working oil pressure is attained following engine start-up.

If any air should become trapped in the lower chamber of the HVL, the compressibility of this air will result in faulty valve operation, and mechanical noise as the inner plunger makes contact with the outer plunger.



Removal

It is possible to remove the hydraulic valve lifters with the engine and cylinder head 'in situ' by the following procedure:



1. Cam Belt: i) Remove the cam drive belt upper cover. Turn the engine to the timing position, with the crankshaft pulley at the TDC mark, and the timing marks on the camshaft pulleys facing each other and aligned with the cylinder head top face.

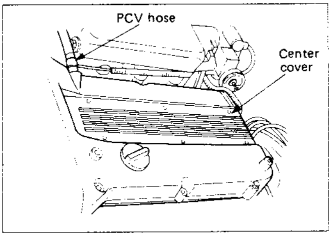
ii) Support the right hand side of the engine, to relieve any load from the right hand engine mount. Remove the bolt securing the engine bracket to the right hand engine mounting rubber. Remove the four socket head bolts securing the aluminium engine mounting crossbeam to the two engine brackets, and remove the crossbeam. If necessary, disconnect the lower oil cooler pipe connection, and the PAS high pressure hose.

iii) Remove the access grommet from the cam belt lower cover, and slacken the cam belt tensioner. Ease the belt off the camshaft pulleys.

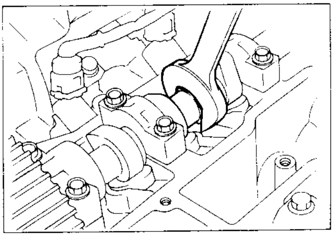
**Precautions**

- Do not attempt to pry or stretch the belt with a screwdriver or any other tool during removal or replacement;
- Do not force the belt to bend or twist excessively, or damage may be caused to the belt core;
- Do not allow oil or any other chemical substances to come into contact with the belt, or belt life will be shortened;
- Do not rotate the crankshaft or camshafts with the drive belt removed, or damage may be caused to the valves and pistons.

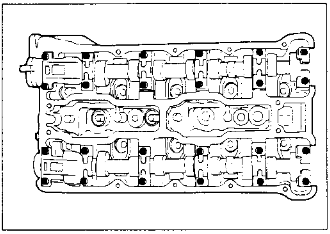
2. Camshaft Cover: Disconnect the PCV hose from the front of the camshaft cover, and the breather hose from the rear.
Release the six screws securing the centre, spark plug well cover, and remove the cover.
Disconnect the spark plug leads, and release from their clips.
Release the twelve screws securing the camshaft cover, and lift off the cover.



3. Camshaft Pulleys: Remove the sprocket bolt from both inlet and exhaust camshafts, using an open ended wrench as shown to hold the camshaft stationary. Withdraw the sprockets.



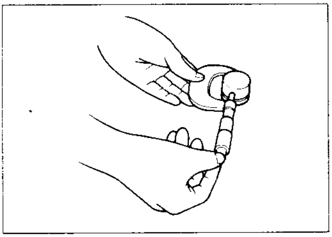
4. Camshafts: Progressively loosen each of the camshaft bearing caps on one camshaft. Do not allow the shaft to be subjected to a severe bending stress by leaving only one cap clamping the shaft.
Note or mark the fitting position of each of the bearing caps before removing the caps, camshaft and front oil seal.
Repeat for the remaining shaft.



5. HVL: Use a rubber sucker or similar to remove each hydraulic valve lifter, one at a time to avoid mixing positions. Alternatively, mark each HVL with its fitted position. After withdrawing, keep the HVL with its oil feed hole uppermost, to prevent oil draining out from it.

Replacement

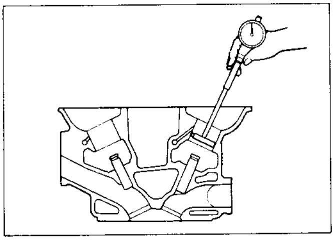
1. Inspection: i) Visually inspect the HVL for pitting and other damage, and replace if necessary.
Measure the HVL outside diameter and replace if outside specification;



HVL Diameter mm (in)

| New | Service Limit |
|---|---|
| 38.00 (1.496) | 37.95 (1.494) |

ii) Check the HVL to cylinder head clearance by measuring the HVL bore size in the head, and subtracting the HVL diameter.

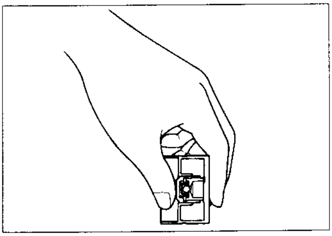


HVL Clearance mm (in)

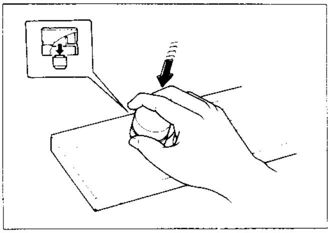
| New | Service Limit |
|---|---|
| 0.01 - 0.04<br>(0.0004 - 0.0016) | 0.20<br>(0.008) |

If clearance exceeds specification, replace the cylinder head and/or HVL.

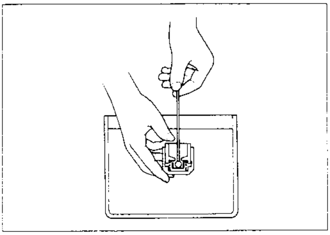
2. HVL: i) Hold the HVL with oil feed hole uppermost, and check that the HVL contains no air by pressing the plunger as shown. Only a slight movement should be felt.



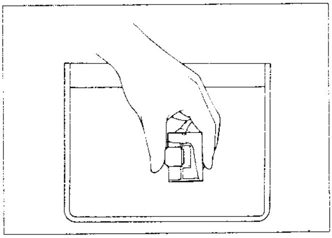
ii) If significant movement of the plunger can be felt, the HVL must be bled of air by the following procedure:
Remove the plunger assembly from the HVL by tapping sharply on a clean timber surface.



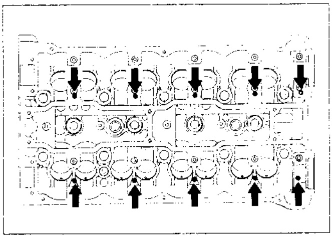
iii) Immerse the plunger assembly in light oil (engine oil is too viscous for this operation), and use a stiff wire to push the check ball valve open. This allows oil into the plunger assembly which will extend under the action of the spring.



iv) When the plunger is fully extended, transfer the plunger into engine oil, and install into the HVL, oil feed hole uppermost. Once fully fitted, check that the plunger moves only very slightly when pressed.

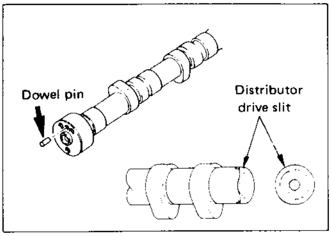


v) Before fitting the HVL into its cylinder head bore, pour engine oil into the oil ports of several cam journals (intake and exhaust), until the ports are filled. Carefully fit the HVL into the head.

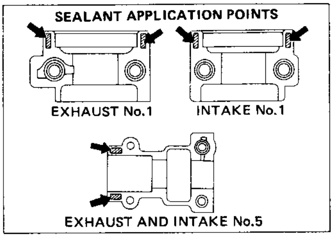


3. Camshafts: Before fitting the camshafts, it is advisable first to turn the crankshaft approx 90° to bring the pistons half way down the bores, and avoid any possibility of valve/piston contact during assembly.

Coat the camshaft journals and HVL tops with copious amounts of engine oil before laying the camshafts in position. Fit the camshaft with the distributor drive slot to the exhaust side. and position both shafts with the pulley dowel uppermost.

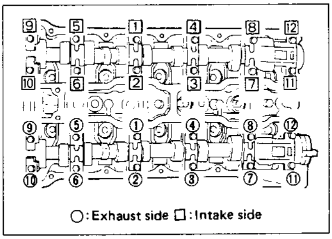

Dowel pin
Distributor drive slit

4. Camshaft Bearing Caps: On both inlet and exhaust sides: remove any oil from the contact surfaces of nos. 1 & 5 bearing caps on the cylinder head.
Apply sealant A100E6173 (TB-1207B) to the contact surfaces of nos. 1 & 5 bearing caps as shown in the illustration.
Fit the bearing caps into position.


SEALANT APPLICATION POINTS
EXHAUST No.1
INTAKE No.1
EXHAUST AND INTAKE No.5

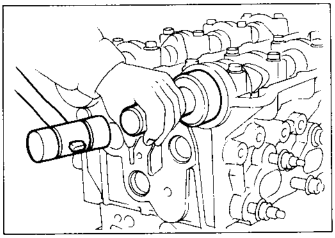
5. Tightening Bearing Caps: Tighten the camshaft bearing caps progressively, and avoid applying an excessive bending stress at any time. Finally torque the cap bolts in the sequence shown.

Torque = 10 Nm (7.6 lbf.ft)


9 5 1 4 8 12
10 6 2 3 7 11
⑨ ⑤ ① ④ ⑧ ⑫
⑩ ⑥ ② ③ ⑦ ⑪
○: Exhaust side □: Intake side

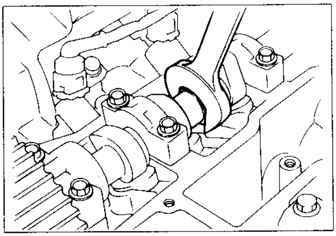
6. Front Oil Seal: Apply engine oil to the lip of a new camshaft front oil seal, and fit into position using the special tool.

Seal installer T000T1015

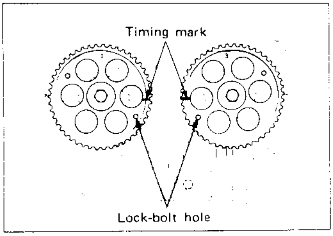


7. Camshaft Pulleys: The camshaft pulleys are identified by an 'I' for inlet, and an 'E' for exhaust.
Fit the pulleys onto the correct shaft, with the dowel properly located, and retain with the pulley bolts. Torque tighten, holding the shafts with an open ended spanner.

Torque = 59 Nm (43 lbf.ft)

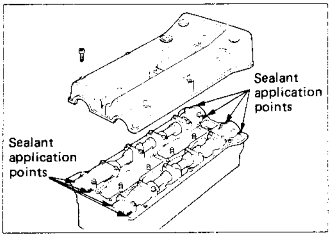


8. Timing Belt: i) Align the timing marks on the camshaft pulleys towards each other, and in line with the cylinder head top face.



ii) Turn the crankshaft back to TDC, and carefully slide the belt onto the camshaft pulleys without disturbing the positions of the shafts. Tension the belt as detailed in section EC.4.

9. Cam Cover: i) Apply a 2 - 3 mm width bead of sealant A100E6173 (TB-1207B) to the positions shown in the illustration. Fit the gasket into position, fit the cover, and secure with the bolts.

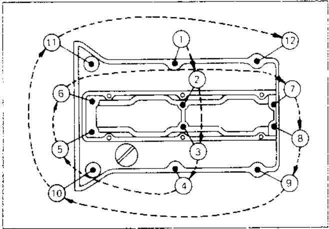


ii) Tighten the cam cover fixings in the order shown to the specified torque.

Torque: 3 Nm (26 lbf.in)

Refit the cam cover breather hoses, spark plug leads and clips, and plug well cover.

10. Cam Belt Cover: Refit the cam belt upper cover and torque tighten to; 10 Nm (7 lbf.ft).



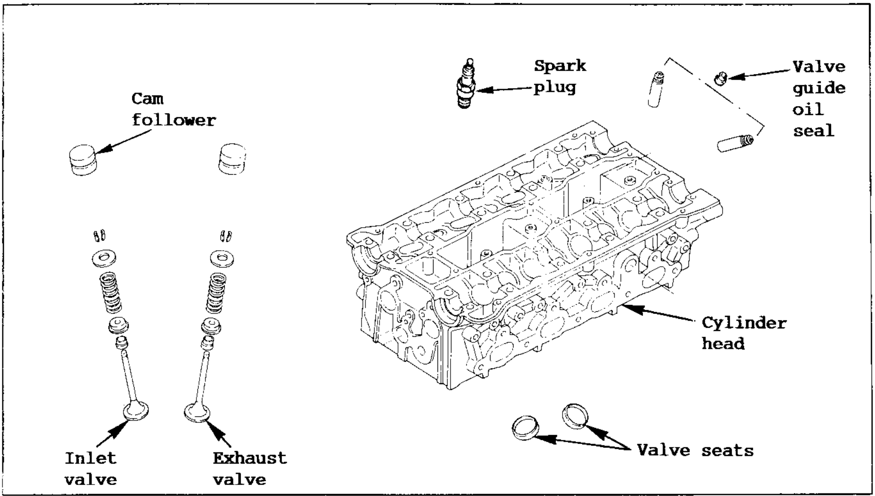
EC.8 - CYLINDER HEAD ASSEMBLY

The cylinder head complete with inlet manifold/plenum and exhaust manifold/ turbo can be removed with the engine and topshell 'in situ'.

To Remove

1. FUEL PRESSURE RELIEF PROCEDURE
- Trip the inertia switch (in battery compartment (RHD) or LH speaker box (LHD)) to disconnect the fuel pump feed, and start the engine.
- After the engine stops from fuel starvation (crank for at least 60 secs if non starter), crank for at least 5 seconds to reduce the remaining fuel pressure.
- Use a shop towel to absorb the small amount of pressurised fuel remaining as the fuel feed connection at the back of the engine is released (use two spanners). Also release the fuel return pipe.

2. Disconnect battery earth cable, and drain cooling system.



3. Throttle Valve Body: Disconnect the throttle cable from the quadrant and abutment, air intake trunking, and EGR vacuum pipe (beneath valve body).

4. Common Chamber Connections: Disconnect the following from the common chamber:
- boost gauge and MAP sensor hoses; )
- earth lead; ) RH end of chamber
- oil cooler pipe bracket )
- 'P' clip at back of engine for battery cables )
- evap. can purge and int. ventilation hoses; ]
- EGR capsule hose; ] LH end of chamber
- M.A.T. sensor electrical connector; ]
- brake servo vacuum hose; ]

5. Power Steering Pump: Release the power steering pump bracket from the engine and support clear.

6. Turbocharger Connections: Release the following connections from the turbo:
- oil feed pipe and return hose;
- water return hose to water rail;
- wastegate solenoid pressure hose;
- compressor inlet and outlet trunking;
- oxygen sensor lead.

7. Exhaust Connections: Release the downpipe from the bottom of the starter catalyst housing, and the catalyst housing frpm its support bracket. Also release the dipstick tube top support fixing.

8. Thermostat Housing: Release the following from the thermostat housing:
- heater feed and return hoses;
- hose from thermo housing to water rail;
- outlet hose to radiator and air bleed hose to header tank.

9. Crankcase Breather: Release the hoses from the oil separator on the back of the cylinder head (Turbo), or the breather hose from the cam cover (N.A.).

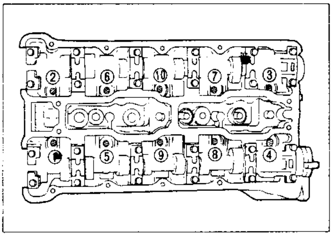
10. Engine Harness: Unplug the two main engine harness connectors at the rear of the header tank, and the 3 connectors and earth lead to the ignition coil pack. Release the grey in line connector (above the starter motor) to the knock sensor. Release the earth braid from the RH front of the cylinder head.

11. Cam Belt: Remove the cam belt upper cover and turn the engine to the timing position with the crank pulley aligned with the TDC mark, and the timing marks on the two camshaft pulleys facing each other (see section EC.4). Remove the grommet from the access hole in the cam belt lower cover, and use a spline socket wrench to loosen the tensioner pulley clamp bolt. Rotate the pulley clockwise to slacken the belt, and slide the belt off the cam pulleys.

12. Camshaft Cover: Remove the cover from the spark plug well, disconnect the plug leads and release from their clips. Release the twelve screws securing the camshaft cover and lift off.

13. Cylinder Head Bolts: Progressively loosen the head bolts in the order shown, before removing the bolts, and lifting the cylinder head assembly clear. Do not lay the head face downwards on a hard surface, or the joint face may be damaged.

14. Follow the procedure in EC.7 to remove the camshafts and hydraulic valve lifters.



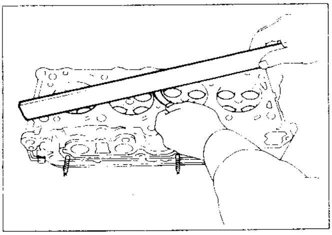
15. Valve & Spring Assemblies: Use a valve spring compressor (T000T1016) to remove the spring retainer collets, and disassemble each valve, spring, spring retainer, collet pair and valve stem seal. Keep each set of parts separate and identified with its fitting position.

Inspection

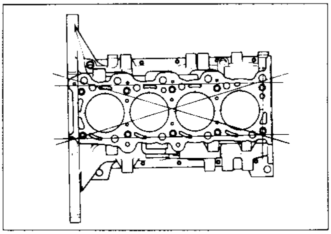
1. General: Carefully clean all parts, and use compressed air to remove any foreign matter from oilways in the cylinder head. Take care, when removing carbon deposits from the combustion chambers, not to scratch the head joint face. Thoroughly inspect the cylinder head for any signs of cracking in the combustion chambers or exhaust ports, and externally for cracks in the water jacket. If any such signs are apparent, the cylinder head must be replaced.

2. Flatness: Use a straight edge and feeler gauge to check the cylinder head bottom face, and manifold joint faces for flatness. If distortion exceeds specification, the face must be machined, or the head replaced.

Bottom Face:
flatness deviation
- new; 0.05 mm (0.002 in) max
- service limit; 0.20 mm (0.008 in)
max metal removal; 0.40 mm (0.016 in)
min head height; 129.1 mm (5.083 in)
Head Manifold Faces:
flatness deviation
- new; 0.05 mm (0.002 in) max
- service limit; 0.40 mm (0.016 in)



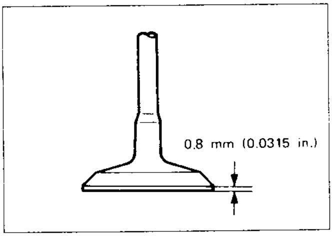
3. Cylinder Block Face: Carefully clean the top face of the cylinder block, without scratching the surface, or dropping any material into the bores or water jacket. Use a straight edge and feeler gauge to check flatness. If distortion exceeds the service limit, the block must be either machined, or replaced.



flatness deviation - service limit; 0.20 mm (0.008 in)
permissible metal removal; 0.40 mm (0.016 in)
minimum usable block height; 245.60 mm (9.669 in)

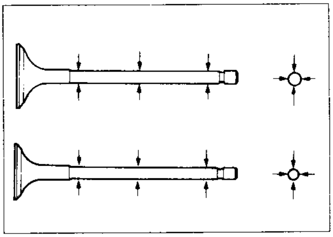
4. Valves: i) Taking care not to damage the seat contact face on the valve, remove all carbon deposits, and carefully inspect the valve stem and seating face for signs of damage or abnormal wear. If found, the valve and guide must be replaced as a set.

ii) Measure the valve head edge thickness. If the thickness is less than specified, the valve and guide must be replaced as a set.



valve head edge thickness:
service limit; 0.8 mm (0.032 in)

iii) Measure the valve stem diameter along its length. If at any point the diameter is less than specified, the valve and guide must be replaced as a set.



Valve stem diameter: mm (in)

| | New | Service Limit |
|---|---|---|
| Inlet | 5.957 - 5.977<br>(0.2345 - 0.2353) | 5.900<br>(0.2323) |
| Exhaust | 5.952 - 5.970<br>(0.2343 - 0.2350) | 5.900<br>(0.2323) |

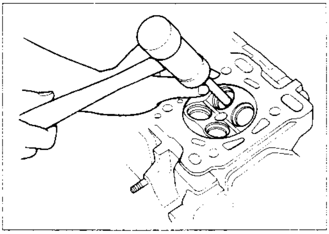
5. Valve Guides: i) Examine the valve stem tip for signs of uneven wear or damage. If found, replace the valve and guide as a set.

ii) Check valve stem to guide clearance by measuring the inside diameter of the guide and subtracting the stem diameter. If the clearance exceeds specification, replace the valve and guide as a set.

Stem to guide clearance: mm (in)

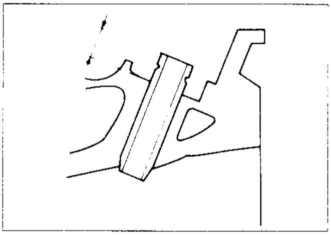
| | New | Service Limit |
|---|---|---|
| Inlet | 0.023 - 0.056<br>(0.0009 - 0.0022) | 0.200<br>(0.0079) |
| Exhaust | 0.030 - 0.063<br>(0.0012 - 0.0025) | |

6. Guide Replacement: i) Use the special tool, from the combustion chamber side, to drive the valve guide out from the head.



Valve guide drift T000T1017

ii) Apply engine oil to the outside of a new guide, and use the special tool to drive the guide into position from the camshaft side. Check the valve guide height.

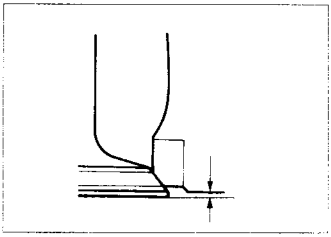


Guide standout mm (in)

| Inlet | Exhaust |
|---|---|
| 15.0 (0.59) | 15.5 (0.61) |

Check stem clearance as in (5,ii) and if insufficient, use a 6 mm reamer to obtain the specified clearance.

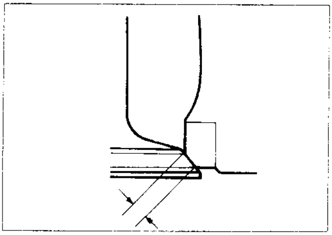
7. Valve Seat Inspection: i) Measure the valve seat recession by installing a new valve, and measuring the standout of the valve head above the combustion chamber surface. If the dimension is less than specified, the valve seat insert should be replaced.



Valve standout: mm (in)

| New | Service Limit |
|---|---|
| 1.10 (0.043) | 0.60 (0.024) |

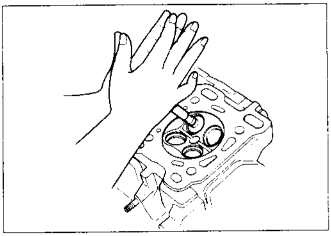
ii) Inspect the contact surface, and measure the valve seat contact width. If necessary, recut the seat surface, and use appropriate cutters to correct seat width.



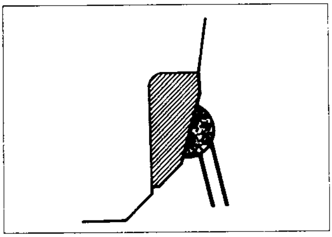
Contact width: mm (in)

| | New | Service Limit |
|---|---|---|
| Inlet | 1.50 (0.059) | 2.20 (0.087) |
| Exhaust | 1.30 (0.051) | 2.00 (0.079) |

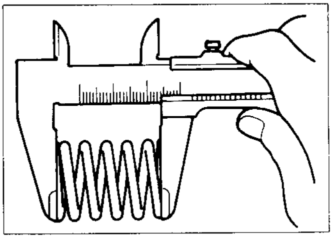
8. Valve Seat Repair: Remove all carbon from the valve seat, and use a 45° cutter to remove only as much material as is necessary to provide a sound seating surface. Check the contact width and contact position on the valve, and use appropriate cutters as necessary to correct. Hand lap the valve and seat using grinding paste. Remove all traces of paste on completion.



9. Valve Seat Replacement: Arc weld a rod to the seat at several points taking care not to damage the aluminium of the head. Cooling of the rods will tend to shrink the seat, allowing it to be withdrawn by striking the rods.
Thoroughly clean the seat recess in the head. Heat the whole cylinder head to a temperature NOT EXCEEDING 200°C, and freeze the insert with dry ice to a temperature NOT LESS THAN minus 80°C. With the aid of a suitable tool, press the insert into place.
Cut the valve seating face with a 45°C cutter, noting contact width, position and valve standout as detailed above.



10. Valve Spring Inspection: i) Measure the free length of the springs, and replace if below specification.

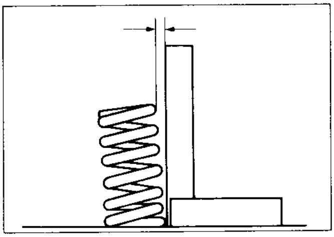


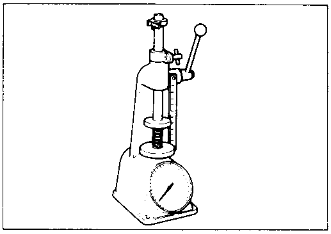
Free length: mm (in)

| New | Service Limit |
|---|---|
| 44.7 (1.76) | 43.2 (1.70) min. |

ii) Measure the valve spring squareness using a surface plate, and replace the spring if outside tolerance.

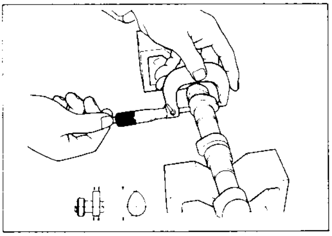
Squareness: service limit; 1.0 mm (0.04 in)





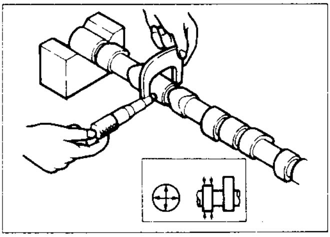
iii) Use a spring tester to measure the spring tension at the installed length. Replace the spring if tension is below specification.

Tension at installed length of 38.2 mm (1.50 in): service limit; 20 kg (44.1 lb)



11. Camshafts Inspection: i) Use a micrometer to measure each cam lobe height and calculate the maximum variation. Replace the camshaft if any height measurement is below specification, or if the maximum variation is exceeded.

Lobe height: 39.02 mm (1.536 in) min.
Max. variation: 0.05 mm (0.002 in)

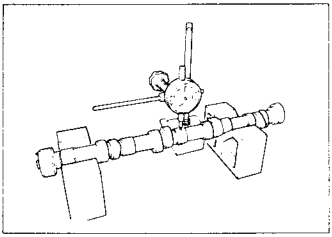


ii) Use a micrometer to measure the diameter and wear variation of each camshaft journal. Replace the camshaft if either the diameter or wear variation exceeds specification.

Journal diameter: mm (in)

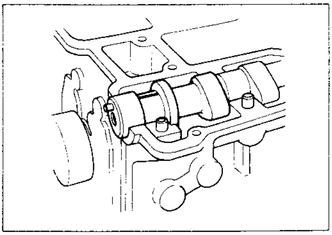
| New | Service Limit |
|---|---|
| 25.95 - 25.96<br>(1.021 - 1.022) | 25.80<br>(1.016) |

Wear variation:
service limit; 0.05 mm (0.002 in)



iii) Place the camshaft on 'V' blocks and measure the maximum run-out at the journals using a dial gauge. Replace the camshaft if the run-out exceeds specification.

Run-out: service limit; 0.10 mm (0.004in)

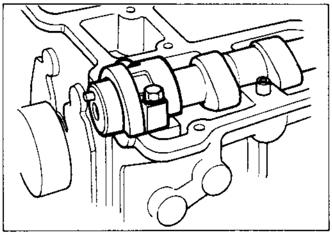


iv) Measure the oil clearance at each camshaft journal using plastigage:
- clean the camshaft journals and bearing surfaces in the head and bearing caps.
- Place the camshaft into position, and place a strip of plastigage on each journal as shown.

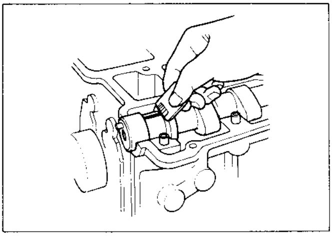
- fit the bearing caps in their correct positions, and torque tighten the fixings.

Torque: 10 Nm (7.6 lbf.ft)

Do NOT turn the camshaft.



- remove the bearing caps and measure the plastigage at its widest point. Replace the cylinder head and/or camshaft if the clearance exceeds the specified limit.

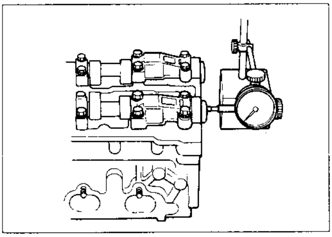


Oil clearance: mm (in)

| New | Service Limit |
|---|---|
| 0.027 - 0.078<br>(0.0012 - 0.0036) | 0.150<br>(0.0059) |

- clean the plasigage from the camshaft and bearing caps.

v) Measure the camshaft end float: Clean the camshaft, cylinder head and bearing caps, fit the camshaft and bearing caps in position, and torque tighten to 10 Nm (7.6 lbf.ft).
Use a dial gauge to measure the camshaft end float, and replace the cylinder head and/or camshaft if outside specification.

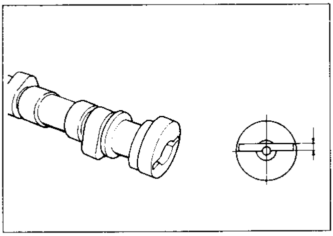


Camshaft endfloat: mm (in)

| New | Service Limit |
|---|---|
| 0.05 - 0.15<br>(0.002 - 0.006) | 0.20<br>(0.008) |

vi) Measure the distributor drive slot width and replace the camshaft if the dimension exceeds specification.

Distributor drive slot width:
service limit; 5.00 mm (0.196 in)

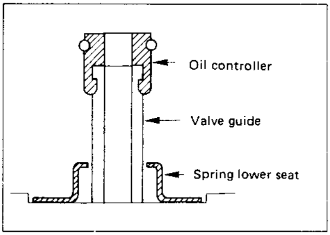


Re-assembly

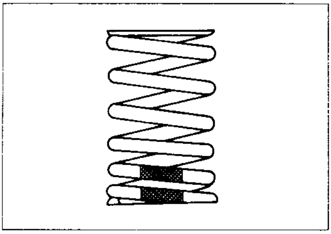
Thoroughly clean all parts before assembly, and coat all bearing surfaces with engine oil.

1. Spring Seats & Stem Seals: Fit the valve spring lower seats over the valve guides.
Fit new valve stem oil controllers to the top of each valve guide, using the special tool.

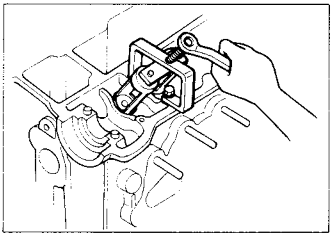
Oil controller replacer: T000T1018



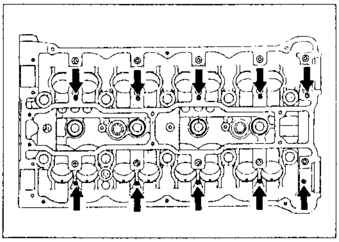
2. Valve and Spring Assemblies:
i) Lubricate the valve stems, and fit the valves into the guides; in the original positions if re-using valves.
Fit the springs into position with the close coiled end (identified by blue-green paint) towards the head.



ii) Fit the spring retainer onto the top of each spring, and use a valve spring compressor (T000T1016) to permit the split collets to be fitted.
Settle the collets by tapping lightly around the retainer with a soft hammer.
**Note:** When compressing the spring, take care not contact and damage the valve stem oil controller.

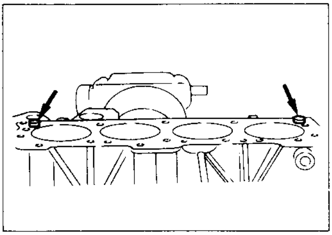


3. HVL: Pour oil into the ports of several cam journals (both intake and exhaust), until filled. Lubricate and fit the hydraulic valve lifters, after ascertaining that that no air is present (see section EC.7).



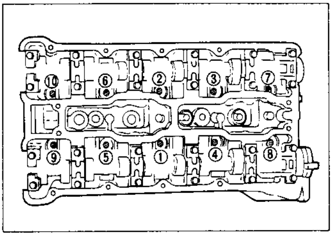
To Replace

1. Gasket: Clean the top face of the cylinder block, and fit the location dowels. Fit a new cylinder head gasket onto the location dowels in the block, with the 'TOP' mark uppermost.



2. Cylinder Head: Fit the cylinder head into position. Apply engine oil to the threads and seating face of the cylinder head bolts.
Fit and tighten the bolts in the sequence shown in the illustration, up to the specified torque in two steps;

Cylinder head torque:
1st step; 40 Nm (30 lbf.ft)
2nd step; 78 Nm (58 lbf.ft)



3. Camshafts: Re-fit the camshafts and cam drive belt as detailed in sections EC.7. and EC.4.

4. Common Chamber & Lower Intake Manifold: Re-fit the induction system as detailed in section EC.6.

6. Miscellaneous: Re-fit remaining components in reverse order to disassembly.

## EC.9 - OIL SUMP

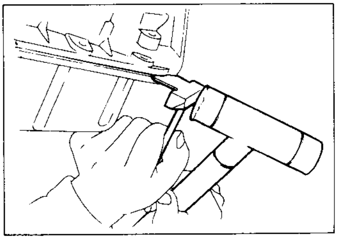
The engine oil sump can be removed with the engine 'in situ' after removing the engine bay underframe, and the exhaust front pipe.

To remove

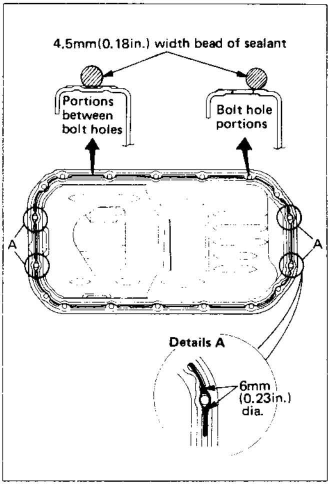
Remove the drain plug, and drain the engine oil from the sump. Remove all fixings securing the sump to the engine. Use the special tool to cut the sealant before attempting to remove the sump.

Seal cutter: T000T1019

**Note:** The sealant is applied to the entire joint face. Do not attempt to pry the sump free, or the joint face may become distorted.

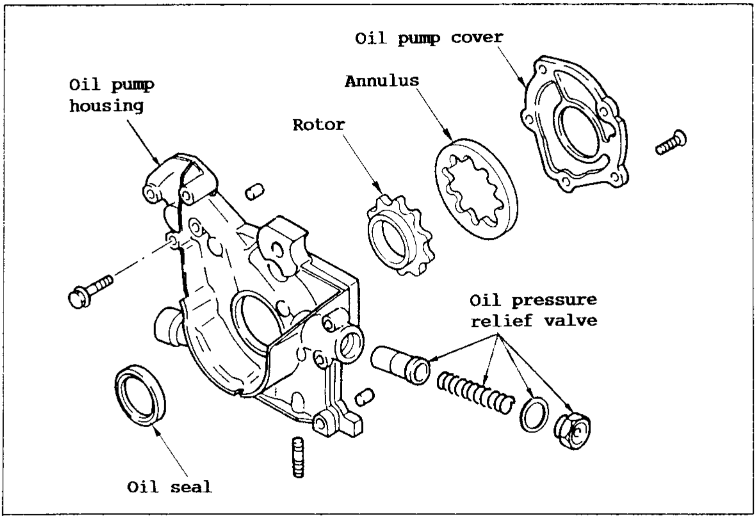


To re-fit
- Completely remove all residual sealant, lubricant and moisture from the joint face. The surface must be perfectly dry.
- Apply a correct width bead of sealant A100E6174 (TB-1207C) to the joint face on the sump flange as shown. There must be no gaps in the bead.
- Fit the sump within 30 minutes of sealant application, and retain with the fixings. Torque tighten to 10 Nm (7.2 lbf.ft).


4.5mm(0.18in.) width bead of sealant
Portions between bolt holes
Bolt hole portions
A
A
Details A
6mm (0.23in.) dia.

## EC.10 - OIL PUMP ASSEMBLY

The trochoidal rotor and annulus type pump is mounted on the front face of the cylinder block, and is driven directly by the front end of the crankshaft.
The pump assembly may be removed with the engine 'in situ'.

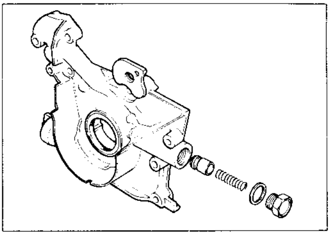

Oil pump cover
Oil pump housing
Annulus
Rotor
Oil pressure relief valve
Oil seal

Disassembly & Inspection
1. Sump: Drain the engine oil, and remove the sump as detailed in section EC.9.

2. Cam Drive Belt: Remove the camshaft drive belt as detailed in section EC.4.

3. Crankshaft Toothed Pulley: Withdraw the cam belt drive pulley from the crankshaft taking great care not to damage the flange. Remove the woodruff key.

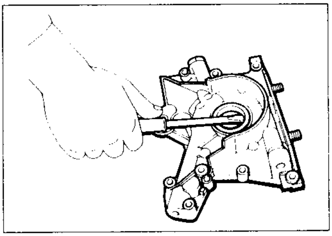
4. Oil Pump Assembly: Release the oil pump assembly fixing bolts, and withdraw the pump over the end of the crankshaft.



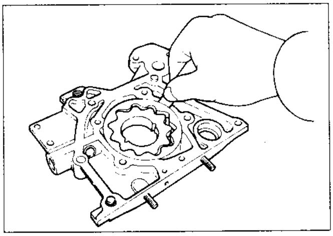
5. Relief Valve: Remove the blanking plug and washer, coil spring and valve plunger.

- inspect the plunger and bore for signs of scoring, or excessive wear.
- check that the plunger slides freely in the bore without binding.

Replace components as necessary if any parts are in doubt.



6. Inspection: Release the five screws, and remove the oil pump cover. Clean the rotor, annulus, cover and housing, noting which way round each gear is fitted.
Prise out the oil seal.
Examine all the wearing surfaces closely for any signs of scoring, scuffing or undue wear. Replace any components showing such signs.

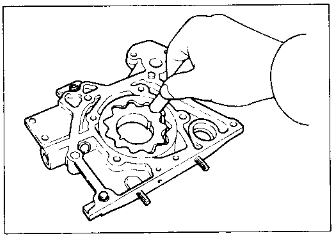


7. Rotor & Annulus: Refit the rotor and annulus in their original positions in the housing, and measure the clearances as shown.

Annulus/housing clearance:

mm (in)

| New | Service Limit |
|---|---|
| 0.10 - 0.18<br>(0.004 - 0.007) | 0.20<br>(0.008) |



Gear tip clearance:

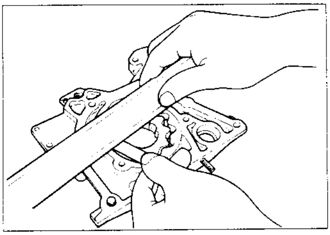
mm (in)

| New | Service Limit |
|---|---|
| 0.06 - 0.22<br>(0.002 - 0.009) | 0.30<br>(0.012) |

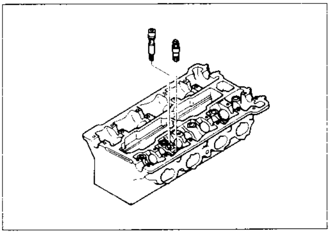
Side clearance:

mm (in)

| New | Service Limit |
|---|---|
| 0.025 - 0.075<br>(0.001 - 0.003) | 0.100<br>(0.004) |



8. Cylinder Head Check & Relief Valves: Remove the check and relief valves from the oil gallery feed to the cylinder head, and check for free operation and cleanliness of the valves.
When refitting, apply engine oil to the 'O' rings, and tighten to the correct torque.



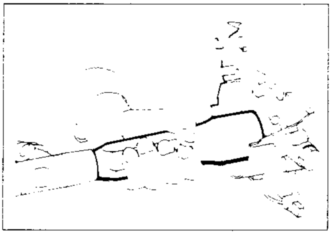
Torque setting:
- relief valve (long); 19 Nm (13.7 lbf.ft)
- check valve (short); 25 Nm (18 lbf.ft)

Re-assembly

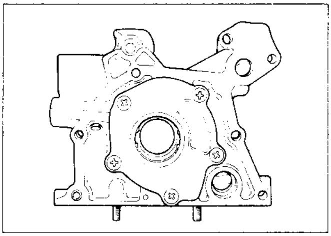
1. Oil Seal: Fit a new oil seal into the pump housing using the special tool.

Seal installer T000T1021

Apply engine oil to the lip of the seal after installation.



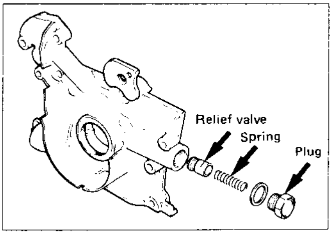
2. Rotor & Annulus: Lubricate the rotor and annulus with engine oil, and fit into the oil pump housing in the correct orientation. Fit the oil pump cover (using NO sealing compound) and attaching screws. Tighten the screws in two stages, with the first step to only half the specified torque.



Torque: 10 Nm (7.2 lbf.ft)

After tightening, check that the gear rotates smoothly.

3. Relief Valve: Apply engine oil to the relief valve plunger, and install the plunger, spring, plug and washer. Torque tighten the plug.

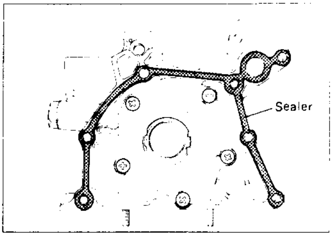


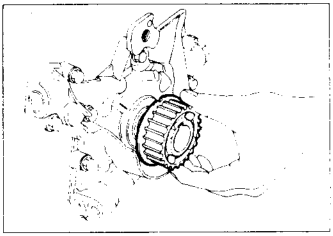
Torque; 37 Nm (27 lbf.ft)

4. Oil Pump Assembly: Clean the joint faces on the oil pump and cylinder block, and apply sealant A100E6173 (TB-1207B) to the oil pump joint face as shown.
Turn the oil pump gear to match the positions of the driving dogs on gear and crankshaft.
Apply engine oil to the lip of the oil seal and carefully fit the pump over the crankshaft, taking great care not to damage the oil seal. Engage the pump driving dogs. Fit the retaining screws and torque tighten.

Torque: 10 Nm (7.2 lbf.ft)

5. Crankshaft Timing Pulley: Fit the woodruff key into the crankshaft, and slide the timing gear into position.





6. Cam Drive Belt: Refit the camshaft drive belt as detailed in section EC.4.

7. Sump: Refit the engine oil sump as detailed in section EC.9. and refill with engine oil. Before starting the engine, crank the engine with the ignition disabled until oil pressure is built up.

## EC.11 - ENGINE REMOVAL/REPLACEMENT

The engine may be removed complete with transmission assembly, upwards through the bonnet aperture without removing the front topshell. Alternatively, the power unit may be dropped down from below after removal of the engine bay underframe. The former, preferred method, is described below:

To Remove

1. FUEL PRESSURE RELIEF PROCEDURE
- Trip the inertia switch (in battery compartment (RHD) or LH speaker box (LHD)) to disconnect the fuel pump feed, and start the engine.
- After the engine stops from fuel starvation (crank for at least 60 secs if non starter), crank for at least 5 seconds to reduce the remaining fuel pressure.
- Use a shop towel to absorb the small amount of pressurised fuel remaining as the fuel feed connection at the back of the engine is released (use two spanners). Also release the fuel return pipe.

2. Preparation: disconnect battery; drain engine oil and power steering fluid; drain coolant; remove front road wheels.

3. Intake Airbox: Disconnect the intake and outlet trunking from the air filter box. Label and disconnect the small bore hoses from the filter box outlet adaptor. Disconnect the hoses from the boost solenoid valve (Turbo only) mounted on the rear of the filter box bracket, and unplug the electrical connector. Remove the filter box bracket and throttle body intake trunking (Turbo).

4. Header Tank: Remove the header tank and mounting bracket.

5. Harness Connections: Unplug the engine harness connector blocks at the left hand end of the engine. Disconnect the H.T. harness from the spark plugs (Turbo) or the H.T. coil lead (N.A.). Unplug harness at ignition coil pack.

6. Water Hoses: Remove the top and bottom hoses, and disconnect the heater hoses from the thermostat housing/by-pass pipe. Disconnect electric water pump hose.

7. Intake Plenum: Disconnect the throttle cable; label and disconnect the two vacuum hoses on the underside of the throttle body and the one or two vacuum hoses from the left hand rear of the intake plenum. Disconnect the vacuum hose from the EGR valve. Disconnect boost gauge and MAP sensor hoses from RH end of plenum, and release brake servo hose from rear of plenum.

8. Control Cables: Disconnect the clutch cable. Pull off the spring clips securing the two inner gearchange cables to the gearbox levers, and the spring clips securing the adjuster sleeves to the abutment bracket. Release the cables from the gearbox, taking care to note the positions of the washers for the inner cable eyes.

9. Speedo Cable: Unscrew the speedo cable from its connection at the top rear of the transmission.

10. PAS Reservoir: Release the PAS reservoir clamp, remove and plug the two hoses from its underside, and remove reservoir. Remove the mounting bracket.

11. Oil Cooler Hoses: Disconnect the oil cooler feed and return hose connections at the right hand rear corner of the engine.

12. Earth Leads: Disconnect the earth braid from the right hand top rear of the engine, and the earth lead from the RH end of the plenum.

14. Exhaust Downpipe: Disconnect the exhaust system downpipe from the manifold/ starter catalyst and release the support strap from the back of the cylinder block (if fitted).

15. A/C Compressor (if fitted): Slacken the power steering pump adjuster bolt to allow the belt tension to be slackened, before removing the multi-'V' belt. Remove the compressor top mounting strap, and the lower mounting bolt, and release from the engine without disturbing the hose connections. Support the compressor clear of the engine.

16. PAS Pump (if fitted): Release the high and low pressure hose connections and disconnect the pressure switch electrical connector. Release the PAS pump mounting bracket from the engine, and remove pump and bracket from beneath.

17. Starter & Alternator: Disconnect the main starter motor cable and starter solenoid connector block. Disconnect the main alternator lead, and unplug the electrical connector from the alternator (easier if the oil filter is first removed).

18. Drive Shafts: On each side of the car, release the top ball joint to allow the hub carrier to be leant outwards enabling the drive shafts to be withdrawn from the transmission:

- remove the clip securing the brake hose joint to the top wishbone, and remove the hose from the wishbone bracket.
- mark the position of the camber adjustment eccentrics or plates on the top ball joint to top wishbone inboard fixing bolt, before removing both top ball joint bolts.
- use a pry bar to lever between the transmission casing and the inboard C.V. joint. A sharp shock is required to override the retaining circlip. Do NOT attempt to pull the joint free by pulling on the shaft, or the inboard joint may become disassembled, and require replacement.
- slide the joint off the transmission output shaft, and insert blanking plug T000T1014 on the left hand side to reduce loss of transmission oil.
- support the hub assembly to avoid straining the brake hose.

19. Torque Damper: Release the torque damper from the front of the engine, and remove the damper on USA cars.

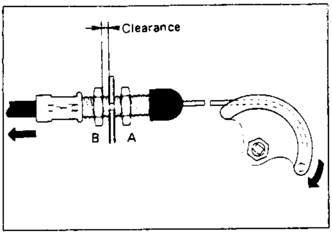
20. Engine Mountings: Support the engine before releasing the rear engine mounting leg from the engine and transmission. Fit a sling to the lifting eyes on the cylinder head, and support the weight of the engine by crane. Remove the left hand engine mounting bolt, and remove the engine mounting bracket, shake damper bracket and spacer plates (if fitted), from the transmission case.

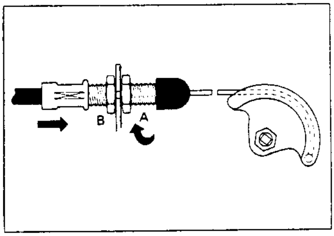
Remove the right hand engine mounting bolt, and lift the engine clear. Raise with a slight 'nose high' attitude, taking great care to guide the transmission casing past the air conditioning pipes and receiver-drier unit.

To Refit

Refit the engine/transmission assembly in the reverse order to removal, noting the following points;

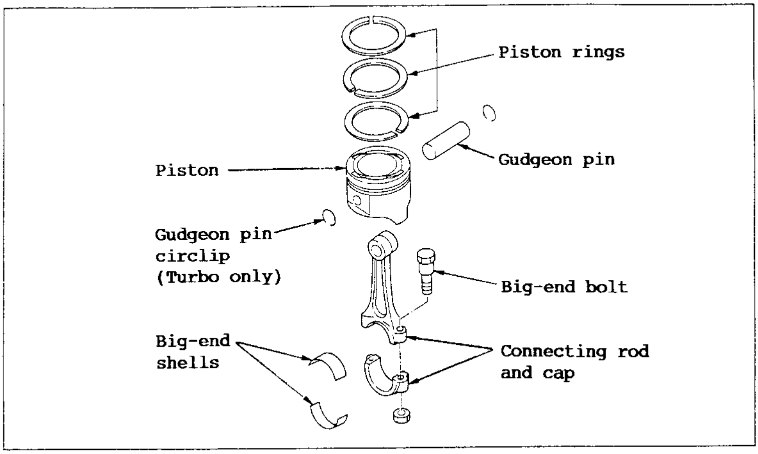
- refit the engine mountings as detailed in section EC.15.
- refill the engine with a recommended lubricant (see EC.2).
- top up the transmission with a recommended lubricant.
- refill the PAS system (if fitted) with a recommended lubricant (see section HC).
- refill the cooling system with a recommended coolant mix (see section KD).
- adjust the clutch cable (see section QD).
- adjust throttle cable: Fit the cable and slacken the adjuster nuts at the plenum abutment bracket. Hold the quadrant fully closed and pull back the outer throttle cable. Adjust locknut B to obtain a clearance between the nut and abutment bracket of 3 mm, then push the adjuster against the bracket and tighten locknut A.





## EC.12 - CYLINDER BLOCK, PISTONS & CONNECTING RODS

Although it is possible to remove the pistons and connecting rods with the engine 'in situ' after removing the cylinder head and sump, preferred practice is first to remove the engine assembly complete.


Piston rings
Gudgeon pin
Piston
Gudgeon pin circlip (Turbo only)
Big-end bolt
Big-end shells
Connecting rod and cap

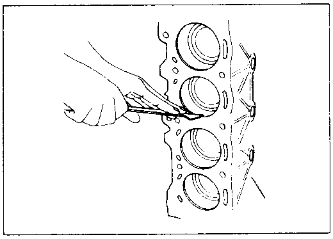
Removal

1. Remove the engine assembly (see section EC.11).

2. Remove the cylinder head assembly (see section EC.8).

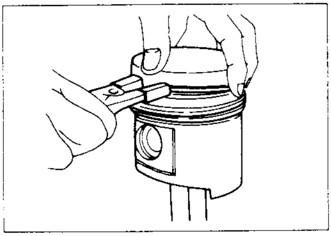
3. Remove the oil sump (see section EC.10).

4. Remove Carbon: Use a scraper to carefully remove the ring of carbon from around the top of each cylinder bore.



5. Big-End Caps: Check that each big-end cap is identified with its fitting position before releasing the two big-end bolts, and removing the connecting rod big-end cap. Push the connecting rod and piston assembly upwards and out of the cylinder bore.

6. Piston Rings: Carefully remove the piston rings from each piston using a piston ring expander, and keep in cylinder sets.

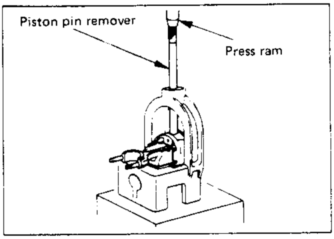


7. Piston Pin: **N/A:** The piston pin is an interference fit in the connecting rod, and a slip fit in the piston. Remove the pin using a piston pin service set and a press.

Piston pin service set T000T1022

**Turbo:** Remove the two circlips, and slide out the gudgeon pin.

Keep the parts removed from each cylinder seperate and identified with their cylinder number. If any parts are to be refitted, it most important that they be re-fitted in their original positions.

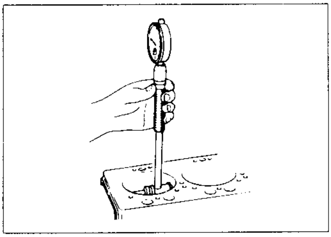


Inspection

1. Cylinder Bore: Use a cylinder gauge to measure the cylinder bore diameter in both the axial and thrust directions. Each measurement should be made at three points.

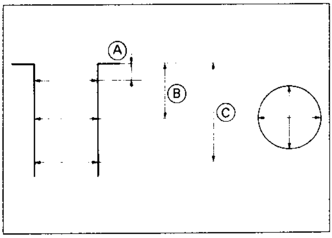
A : 12 mm (0.47 in)
B : 55 mm (2.17 in)
C : 95 mm (3.74 in)

If any of the measured values exceeds the specified limit, reboring is required.



Bore size: mm (in)

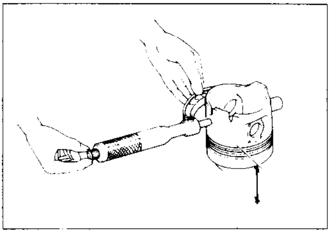
| Bore Size | New Diameter | Service Limit |
|---|---|---|
| Standard | 80.000 - 80.030<br>(3.1496 - 3.1508) | 80.200<br>(3.1575) |
| Oversize 0.50 | 80.500 - 80.530<br>(3.1693 - 3.1705) | 80.700<br>(3.1772) |
| Oversize 1.00 | 81.000 - 81.030<br>(3.1890 - 3.1902) | 81.200<br>(3.1970) |



2. Piston: Carefully clean the pistons and examine for cracking, scoring or any other signs of abnormal wear. Measure the piston diameter across the thrust axis at the grading position.

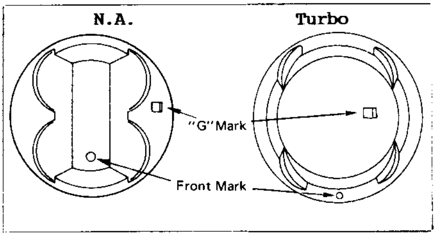
Grading position = 30.0 mm (1.18 in) from crown.

Calculate the maximum piston/bore clearance. If the service limit is exceeded, a rebore is required.

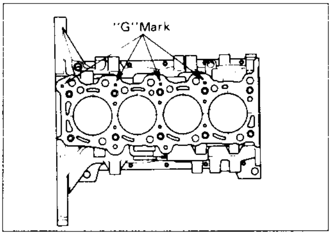


Piston/bore clearance: mm (in)

| | New | Service Limit |
|---|---|---|
| N.A. | 0.048 - 0.068<br>(0.0019 - 0.0027) | |
| Turbo | 0.058 - 0.078<br>(0.0023 - 0.0031) | |



3. New Cylinder Block: If a new cylinder block is being used, the bore size has been measured at the factory, and the bore grade stamped on the top face of the block in the positions shown. Fit standard size pistons of the same grade marking (A, B or C).



4. Reboring: Oversize pistons of + 0.5 mm and + 1.0 mm are available. After establishing which oversize is appropriate, the pistons must be obtained and measured before the actual reboring size can be calculated.

Before allocating the new pistons to individual bores, combinations of pistons and connecting rod assemblies should be weighed to establish the optimum pairings for balance. The weight variation between sets (piston, pin, rod, cap and bolts) should be less than 3 g (0.1 oz).

Boring diameter = D + C - H where;

D = piston diameter. Measure as in (2).
C = required piston/bore clearance - N/A: 0.048 - 0.068 mm (0.0019 - 0.0027 in).
- Turbo: 0.058 - 0.078 mm (0.0023 - 0.0031 in)
H = honing allowance of 0.01 - 0.03 mm (0.0004 - 0.0012 in).

The difference between individual cylinder bore diameters should be less than 0.02 mm (0.0008 in).
After boring and honing, recheck the piston/bore clearance.

Piston/bore diameter - **N/A** mm (in)

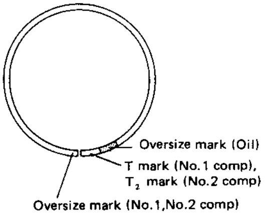
| Grade | Piston Diameter | Finished Bore Diameter (ref) | Required Piston/ Bore Clearance |
|---|---|---|---|
| Standard<br>A (ref) | 79.942 - 79.952<br>(3.1473 - 3.1477) | 80.000 - 80.010<br>(3.1496 - 3.1500) | 0.048 - 0.068<br>(0.0019 - 0.0027) |
| Standard<br>B (ref) | 79.953 - 79.962<br>(3.1477 - 3.1481) | 80.011 - 80.020<br>(3.1500 - 3.1504) | 0.048 - 0.068<br>(0.0019 - 0.0027) |
| Standard<br>C (ref) | 79.963 - 79.972<br>(3.1481 - 3.1484) | 80.021 - 80.030<br>(3.1504 - 3.1508) | 0.048 - 0.068<br>(0.0019 - 0.0027) |
| Oversize<br>0.5 mm | 80.445 - 80.465<br>(3.1671 - 3.1679) | TO BE CALCULATED<br>(see above) | 0.048 - 0.068<br>(0.0019 - 0.0027) |
| Oversize<br>1.0 mm | 80.945 - 80.965<br>(3.1868 - 3.1875) | TO BE CALCULATED<br>(see above) | 0.048 - 0.068<br>(0.0019 - 0.0027) |

Piston/bore diameter - **Turbo** mm (in)

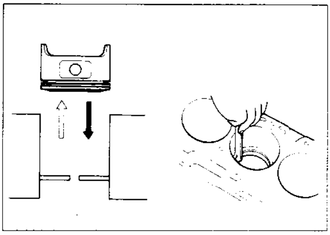
| Grade | Piston Diameter | Finished Bore Diameter (ref) | Required Piston/ Bore Clearance |
|---|---|---|---|
| Standard<br>A (ref) | 79.932 - 79.942<br>(3.1469 - 3.1473) | 80.000 - 80.010<br>(3.1496 - 3.1500) | 0.058 - 0.078<br>(0.0023 - 0.0031) |
| Standard<br>B (ref) | 79.943 - 79.952<br>(3.1474 - 3.1477) | 80.011 - 80.020<br>(3.1500 - 3.1504) | 0.058 - 0.078<br>(0.0023 - 0.0031) |
| Standard<br>C (ref) | 79.953 - 79.962<br>(3.1477 - 3.1481) | 80.021 - 80.030<br>(3.1504 - 3.1508) | 0.058 - 0.078<br>(0.0023 - 0.0031) |
| Oversize<br>0.5 mm | 80.435 - 80.455<br>(3.1667 - 3.1675) | TO BE CALCULATED<br>(see above) | 0.058 - 0.078<br>(0.0023 - 0.0031) |
| Oversize<br>1.0 mm | 80.935 - 80.955<br>(3.1864 - 3.1872) | TO BE CALCULATED<br>(see above) | 0.058 - 0.078<br>(0.0023 - 0.0031) |

5. Ring Identification: Piston rings may be identified as follows;

| Ring | Std. | +0.5 | +1.0 |
|---|---|---|---|
| 1st comp. | T | T 50 | T 100 |
| 2nd comp. | T2 | T2 50 | T2 100 |
| oil control | Red | Blue | Yellow |



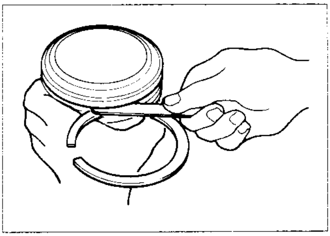
6. Piston Rings: When fitting new piston rings, measure the piston ring end gap by inserting the ring in the bore and using the piston to set the ring square at the narrowest working part of the bore.



End gap: mm (in)

| Ring | End Gap | Service Limit |
|---|---|---|
| 1st comp. | 0.28 - 0.40<br>(0.011 - 0.016) | 0.15<br>(0.059) |
| 2nd comp. | 0.45 - 0.60<br>(0.018 - 0.024) | 0.15<br>(0.059) |
| Oil control | 0.10 - 0.60<br>(0.004 - 0.024) | 0.15<br>(0.059) |

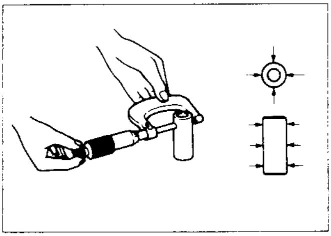
7. Ring Side Clearance: Measure the ring side clearance, and replace the piston assembly if the specification is exceeded.



Ring side clearance: mm (in)

| Ring | New | Service Limit |
|---|---|---|
| 1st comp. | 0.045 - 0.080<br>(0.0018 - 0.0032) | 0.150<br>(0.0060) |
| 2nd comp. | 0.020 - 0.060<br>(0.0008 - 0.0024) | 0.150<br>(0.0060) |

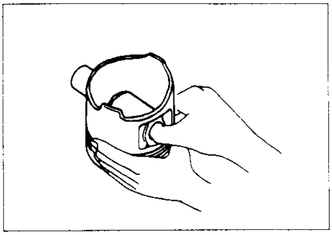
8. Piston Pin: i) Measure the piston pin o/d at three positions, and in two planes as shown. Replace the pin if any measurement is outside specification.



Piston pin diameter: mm (in)

| | New (nominal) | Service Limit |
|---|---|---|
| N.A. | 18.000 (0.7087) | 17.970 (0.7075) |
| Turbo | 20.000 (0.7874) | 19.970 (0.7862) |

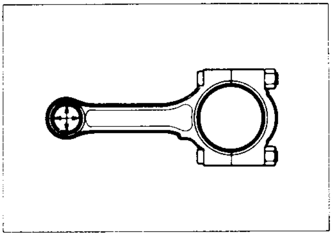
ii) Fit the piston pin into the piston and feel for any free play, or roughness whilst turning. If either can be felt, the clearance should be measured.



Piston/piston pin clearance: mm (in)

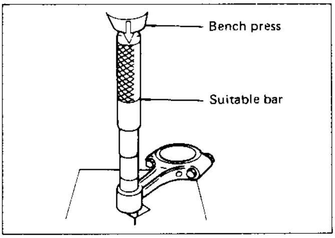
| | New | Service Limit |
|---|---|---|
| N.A. | 0.012 - 0.017<br>(0.0005 - 0.0007) | 0.040<br>(0.0016) |
| Turbo | 0.007 - 0.017<br>(0.0003 - 0.0007) | 0.040<br>(0.0016) |

9. Connecting Rod: i) Measure the inside diameter of the connecting rod small end, and using the measured diameter of the piston pin, calculate the interference fit (N.A.) or clearance (Turbo). If the fit is outside specification on an N.A. engine, replace the connecting rod and piston pin.

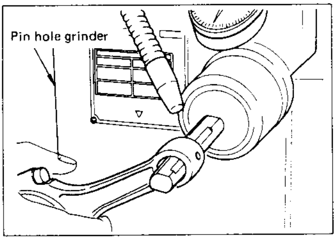


Interference fit (N.A.): 0.020 - 0.041 mm
(0.0008 - 0.0016 in)
Clearance (Turbo): - new 0.008 - 0.017 mm
(0.0003 - 0.0007 in)
- service limit 0.040 mm (0.0016 in)

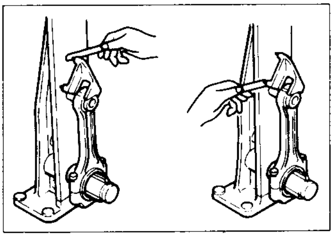
ii) On Turbo engines, if the clearance is outside specification, use a suitable bar and hydraulic press to remove the small end bush. Press a new bush into position with the oil hole aligned.



After fitting a new bush, finish the bore with a pin hole grinder/reamer to achieve the specified clearance.

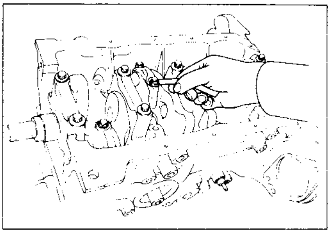


iii) Check the connecting rod for bend or twist using a connecting rod aligner. Replace the rod if outside specification.



Max. distortion per 100 mm (3.9 in):
Bend: 0.15 mm (0.006 in)
Twist: 0.20 mm (0.008 in)

10. Connecting Rod Thrust Clearance: Fit the connecting rod to the crankpin, and torque tighten the cap bolts to 35 Nm (25 lbf.ft). Measure the side clearance between connecting rod and crankshaft.



Thrust clearance: mm (in)

| New | Service Limit |
|---|---|
| 0.20 - 0.35<br>(0.008 - 0.014) | 0.40<br>(0.016) |

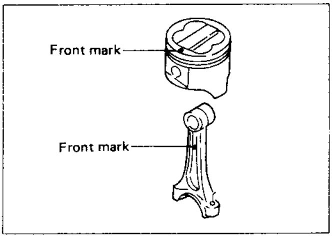
Replace the connecting rod if clearance exceeds specification.

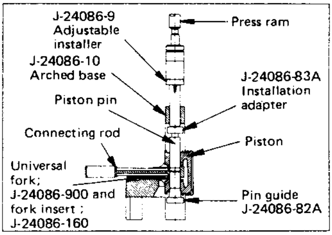
11. Big-end Bearing: To establish the serviceability or selection of the big-end shells, refer to section EC.13.

Re-assembly

1. Piston/Connecting Rod - **N.A.**: The piston pin is an interference fit in the connecting rod small end, and a slip fit in the piston. Assembly is aided considerably if the connecting rod is first heated to a maximum temperature of 250°C using an electric oven. Position the piston and connecting rod with both 'front' marks facing the same way, and use the special tool to install the piston pin.

Piston pin installer T000T1022

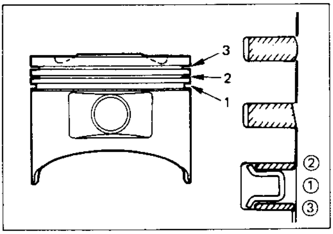

Front mark
Front mark


J-24086-9
Adjustable
installer
J-24086-10
Arched base
Piston pin
Connecting rod
Universal
fork;
J-24086-900 and
fork insert ;
J-24086-160
Press ram
J-24086-83A
Installation
adapter
Piston
Pin guide
J-24086-82A

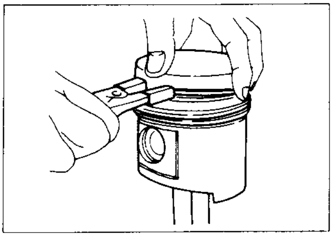
- **Turbo**: Fit one new circlip into the piston, position the connecting rod and piston with both 'front' marks facing the same way, insert the gudgeon pin and retain with the second new circlip.

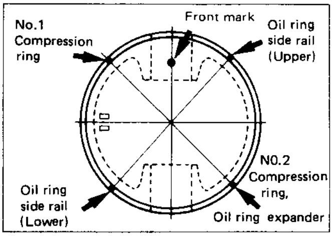
2. Piston Rings: Use a piston ring expander tool to fit the rings to the piston in the following order;

1 - oil control ring
  a) expander ring
  b) lower side rail
  c) upper side rail
2 - 2nd compression ring
3 - 1st compression ring

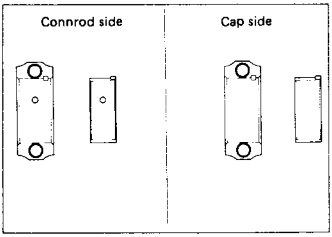


Note that the two compression rings must be fitted the correct way up, with the 'T' (1st compression) or '2T'(2nd compression) mark uppermost.
Arrange the rings so that the gaps are positioned as shown in the diagram.

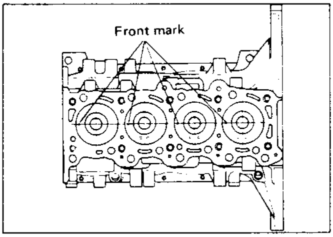



Front mark
No.1 Compression ring
Oil ring side rail (Upper)
NO.2 Compression ring,
Oil ring side rail (Lower)
Oil ring expander

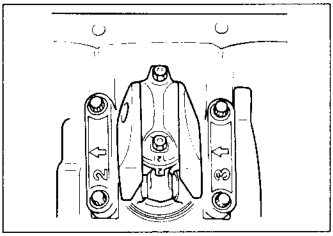
3. Big-End Shells: Fit the bearing shells into the connecting rod and cap, noting that the shell in the rod has an oil hole which must align with the hole in the rod, whereas the shell in the cap is plain. Coat both shells with clean engine oil.


Connrod side
Cap side

4. Piston Installation: Generously lubricate the cylinder walls with clean engine oil. Fit each piston/connecting rod assembly into its correct cylinder, with the 'front' mark facing forwards, using a piston ring compressor.
Take care not to damage the cylinder wall during this process.



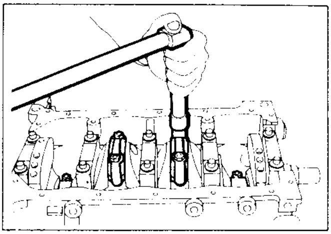
5. Big-end Caps: i) Match the numbered big end caps to their rods, lubricate the crankpins, and fit each cap the correct way round. Lubricate the threads and seating faces of the big-end bolts before inserting.



ii) Tighten the big-end cap nuts in two steps, using the angular tightening method as below:

| 1st Step | 2nd Step |
|---|---|
| 15 Nm (10.8 lbf.ft) | 45 - 60° |

Check that the crankshaft rotates smoothly.



6. Refit the oil sump (section EC.10), cylinder head (section EC.8), and engine assembly (section EC.11).

## EC.13 - CRANKSHAFT, MAIN BEARINGS, BIG END BEARINGS & FLYWHEEL

### Removal

1. Remove the engine assembly (see section EC.11).

2. Remove the cylinder head (see section EC.8).

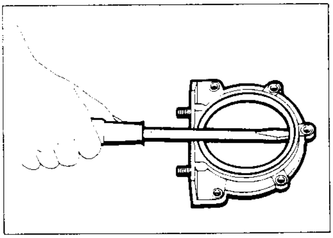
3. Remove the oil sump (see section EC.9).

4. Remove the oil pump assembly (see section EC.10).

5. Remove the piston and connecting rod assemblies (see section EC.12).

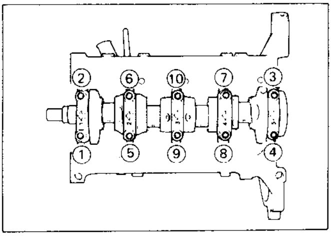
6. Flywheel: Release the six bolts, and remove the flywheel.

7. Rear Seal Housing: Release the five screws and remove the crankshaft rear oil seal housing. Prise out the oil seal using a screwdriver.



8. Oil Pick Up Pipe: Release the two bolts securing the oil pick pipe flange, and the two bolts fixing the pick up pipe bracket, and remove the pick up pipe assembly.

9. Main Bearing Caps: Check that each main bearing cap is marked with its fitting position before releasing the bolts in the order shown, and removing the caps.
Remove the thrust washers from each side of no. 2 main bearing.
Lift out the crankshaft.



Inspection

1. Flywheel: Check the clutch friction surface of the flywheel for signs of excessive wear, scoring or other damage. Replace the flywheel if any are found.

2. Ring Gear: Check the condition of the ring gear teeth in the two positions of maximum wear. To remove the ring gear, use a hacksaw to cut between adjacent teeth, and a chisel to split the gear.

Heat the new ring gear evenly to a temperature not exceeding 200°C and fit onto the flywheel up to the flange. Allow to cool naturally in the air before measuring the ring gear run-out.

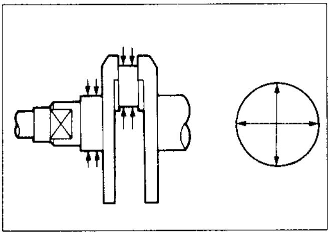
Maximum run-out = 0.1 mm (0.004 in).

3. Crankshaft: The crankshaft is tuftrided to provide a highly durable wearing surface on the journals. Because this nitrizing process is a surface treatment, it is not permissible to regrind the crankshaft.

i) Journal Wear: Measure the diameter and wear variation of the crankshaft main bearing journals, and crankpins. If any dimensions are outside the service limit, the crankshaft must be replaced.

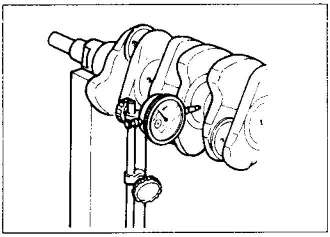
mm (in)

| Dimension | Service Limit |
|---|---|
| Main journal diameter | 51.908 (2.0436) |
| Crankpin diameter | 39.925 (1.5718) |
| Max. wear variation | 0.005 (0.0002) |



ii) Run-out: Set the crankshaft on 'V' blocks, and measure the run-out using a dial gauge. Replace the crankshaft if the measurement exceeds specification.

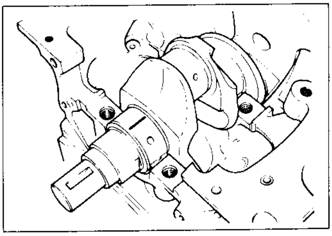
Max. run-out = 0.1 mm (0.039 in)*



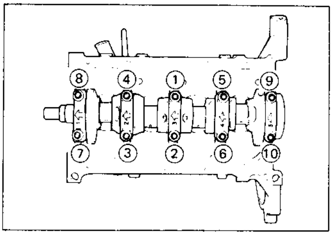
4. Main Bearing Shells: If the crankshaft is found to be servicable, the oil clearance of the main bearings should be checked to establish whether the bearing shells should be replaced.

i) Visually inspect the shells for any signs of scoring or other damage. Replace as a set if any signs are found.

ii) Clean the crankshaft journals, bearing shells and seatings in the block and caps. Assemble the upper shells in their original positions in the block, and fit the crankshaft thrust washers. Carefully fit the crankshaft into position, and apply plastigage to the main bearing journals as shown.

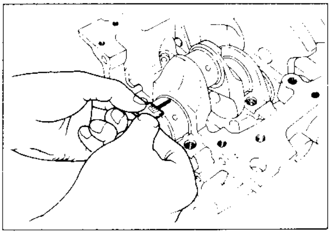


iii) Fit the main bearing caps with shells, and fit the bolts with lubricated threads and seating faces. Torque tighten the bolts in the order shown. Do NOT turn the crankshaft.



Torque; 90 Nm (65 lbf.ft)

iv) Remove the main bearing caps (in reverse order to tightening sequence), and measure the plastigage width to establish the oil clearance. If the clearance exceeds specification, the shell bearings should be replaced as a set.

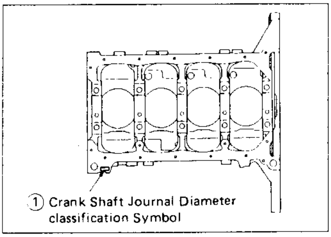


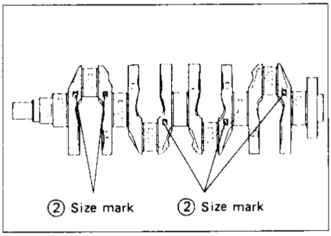
Main bearing oil clearance: mm (in)

| New | Service Limit |
|---|---|
| 0.020 - 0.048<br>(0.0008 - 0.0020) | 0.12<br>(0.0047) |

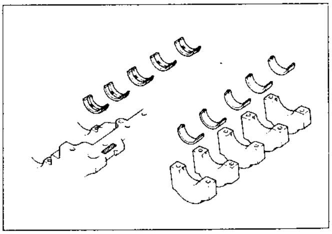
Remove plastigage and clean components.

v) The main bearing shells are available in various thicknesses in order that the optimum oil clearance may be achieved. Both the main bearing bore size in the block, and the main bearing journal diameter on the crankshaft, are graded at the factory, and marked accordingly. These markings must be referred to if renewing cylinder block, crankshaft or bearing shells. The locations of these markings are shown in the diagrams.





Note that all lower main bearing shells are plain, whereas the upper shells have a groove and hole (N.A.) or a groove and two holes (Turbo).



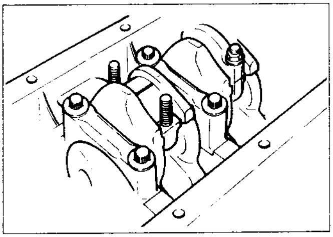
All dimensions are mm

| Cyl. block mark | Diameter of main bearing bore in block | Crankshaft main journal diameter | crank web mark* | bearing colour code | Oil clearance (reference) |
|---|---|---|---|---|---|
| 1 | 55.992 - 56.000 | 51.908 - 51.917 | worn | blue | 0.033 - 0.058 |
| | | 51.918 - 51.928 | - - | blue | 0.022 - 0.048 |
| | | 51.929 - 51.938 | - | black | 0.020 - 0.046 |
| 2 | 55.984 - 55.991 | 51.908 - 51.917 | worn | blue | 0.025 - 0.049 |
| | | 51.918 - 51.928 | - - | black | 0.022 - 0.048 |
| | | 51.929 - 51.938 | - | brown | 0.020 - 0.046 |
| 3 | 55.976 - 55.983 | 51.908 - 51.917 | worn | black | 0.025 - 0.049 |
| | | 51.918 - 51.928 | - - | brown | 0.022 - 0.048 |
| | | 51.929 - 51.938 | - | green | 0.020 - 0.046 |

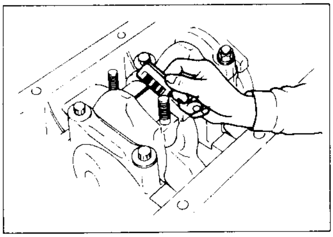
* crank web marks '-' and '- -' are only relevent when using a new crankshaft.

10. Big-end Bearing: Measure the oil clearance at the big-end shell bearings using plastigage;

- clean the big-end bore in the connecting rod and cap, and the crankpin.
- fit the clean big-end shell halves into the rod and cap.
- apply plastigage to the crankpin as shown.



- fit the rod and cap to the crankpin, and torque tighten the bolts to 35 Nm (25 lbf.ft). Do NOT turn crankshaft or rod.
- remove the rod cap, and measure the width of the plastigage.



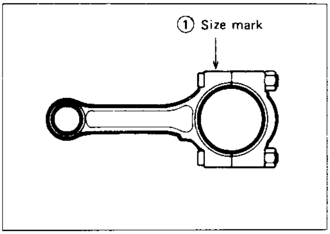
Oil clearance: mm (in)

| New | Service Limit |
|---|---|
| 0.030 - 0.062<br>(0.0012 - 0.0024) | 0.120<br>(0.0047) |

- clean plastigage from the cap and crankpin.

- If the oil clearance exceeds specification, select replacement bearing shells from the following table, by referring to the size marking stamped on the connecting rod as shown.

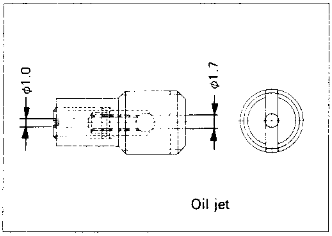
**Note:** Do not confuse this mark with the cylinder numbering mark.



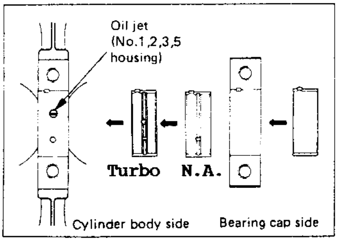
| Marking on connecting rod | Diameter of big end bore in connecting rod | Crank pin diameter | Bearing colour code | Bearing shell thickness (reference) |
|---|---|---|---|---|
| 1 | 42.994 - 43.000 | 39.935 - 39.950 new tolerance 39.925 service wear limit | blue | 1.503 - 1.507 |
| 11 | 42.988 - 42.993 | | black | 1.499 - 1.503 |
| 111 | 42.982 - 42.987 | | brown | 1.495 - 1.499 |

Re-assembly

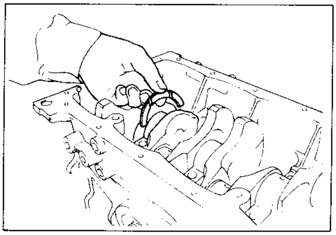
1. Oil Jets (Turbo): Before fitting the bearing shells on Turbo engines, check that the piston cooling oil jets are fitted into main bearings 1,2,3 and 5, and that the jets are clear.



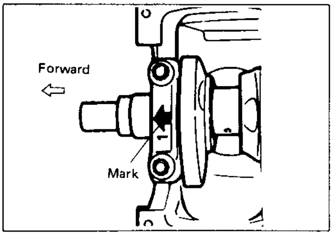
2. Main Bearing Shells: Fit the main bearing shells into the cylinder block and main bearing caps, noting that those in the caps are plain, whereas those in the block have a groove and hole (N.A.) or a groove and two holes (Turbo).



3. Crankshaft and Thrust Washers: Copiously lubricate the bearing shells before carefully fitting the crankshaft into position.
Lubricate and fit the thrust washers into position either side of no. 2 main bearing journal. The oil grooves must face the crankshaft.



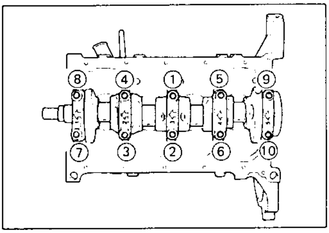
4. Main Bearing Caps: i) Lubricate the bearing shells, and fit the main bearing caps in their correct positions, with the arrow marks pointing towards the front end of the crankshaft. Lubricate the bolt threads and seating faces before installing and semi-tightening.



ii) Torque tighten the main bearing cap bolts in the order shown.

Torque; 90 Nm (65 lbf.ft)

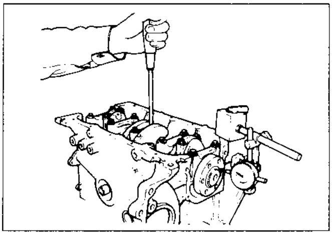
Check that the crankshaft rotates smoothly.



5. Measure Crankshaft Endfloat: Use a dial gauge as shown to measure the crankshaft end float. If the clearance is outside specification, remove no. 2 main bearing cap, and replace the thrust washers as necessary to achieve the correct clearance.

Crankshaft endfloat: mm (in)

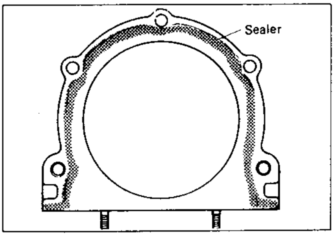
| New | Service Limit |
|---|---|
| 0.06 - 0.24<br>(0.002 - 0.010) | 0.30<br>(0.012) |



6. Piston/Connecting Rod Assemblies: Fit the piston/connecting rod assemblies as detailed in section EC.12.

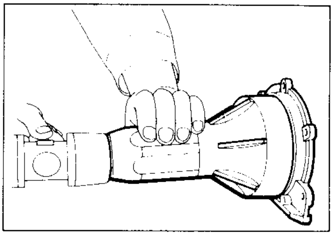
7. Rear Seal Housing: Clean the mating face on the housing and cylinder block and apply sealant A100E6173 (TB-1207B) to the housing as shown. Lubricate the oil seal lip, and fit the housing into position over the location dowels. Retain with new bolts, and torque tighten to 10 Nm (7.2 lbf.ft).

**Note:** Take care not to dislodge the oil seal garter spring.



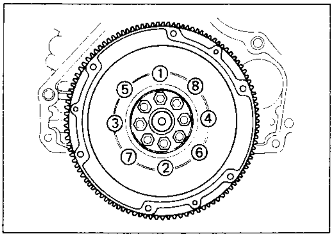
8. Rear Oil Seal: If the rear seal was removed for replacement, fit a new seal into the housing using the special tool.

Seal Installer T000T1024



9. Flywheel: i) Thoroughly degrease the threads in the crankshaft, and the crankshaft and flywheel mating faces. Apply Loctite 262 or similar thread locking compound to the threads of NEW flywheel fixing bolts, insert through the flywheel washer, and secure the flywheel to the crankshaft.
**Note:** Do not apply an excessive amount of sealer to the bolt threads, or the resultant overflow may contaminate the bolt seating face and cause the bolt to work loose.

ii) Hold the flywheel from turning, and tighten the fixing bolts in a diagonal sequence to the specified torque in 2 steps using the angular tightening method as shown in the table.

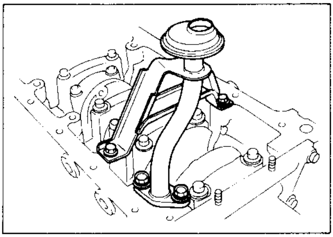


Flywheel bolt tightening:

| 1st step | 2nd step |
|---|---|
| 30 Nm (22 lbf.ft) | 45° - 60° |

10. Oil Pick Up Pipe: Fit the oil pick up pipe to the cylinder block using a new gasket, and torque tighten the fixing bolts.

Torque; 19 Nm (14 lbf.ft)



11. Refit the oil pump assembly (see section EC.10).

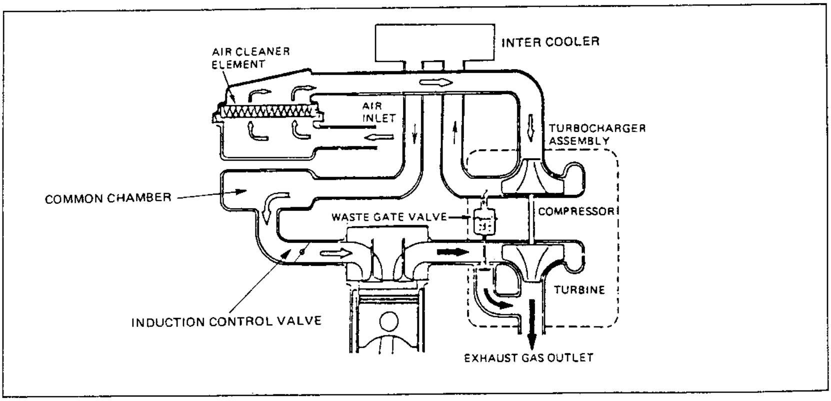
12. Refit the oil sump (see section EC.9).

13. Refit the cylinder head (see section EC.8).

14. Refit the engine assembly (see section EC.11).

## EC.14 - TURBOCHARGER (if fitted)

An IHI turbocharger, type RHB 5 with a water cooled bearing housing and integral wastegate, is bolted to the cast iron exhaust manifold. The exhaust gases spin the turbine wheel at speeds up to 100,000 rpm, before exiting the turbocharger and flowing into the exhaust system. The turbine wheel is fixed to a short shaft supported by fully floating bearings, to the other end of which is fixed the compressor wheel. The compressor draws air from the air filter box and centrifuges the air out of the compressor housing, through the chargecooler radiator to reduce its temperature and increase its density, and into the intake plenum. The extent to which this air is compressed is dependent on throttle opening and engine speed, but is mechanically limited by the exhaust wastegate to a maximum boost pressure of 0.41 bar (6.0 lb/in$^2$). However, an ECM controlled vacuum solenoid valve in the control pressure line to the wastegate capsule, is modulated under certain operating conditions, to vent the control line and allow boost pressures of up to 0.65 bar (9.6 lb/in$^2$) to be developed. See engine management section EMK.2 - T for full details of the boost control strategy.

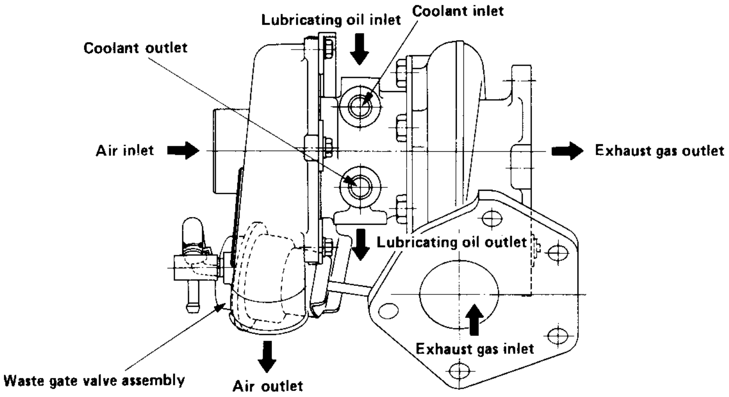


The wastegate consists of a coil spring/pneumatically operated flap valve fitted between the turbine housing inlet and outlet which, when opened, diverts a proportion of the exhaust gas away from the turbine to limit the boost pressure built up in the inlet. The flap valve is linked to an operating capsule which contains a spring to hold the valve shut, and a diaphragm pressure chamber connected by a short hose to the boost pressure at the compressor outlet. As boost pressure builds up, the force in the pressure chamber, opposing the spring pressure, builds up until the flap valve is opened.

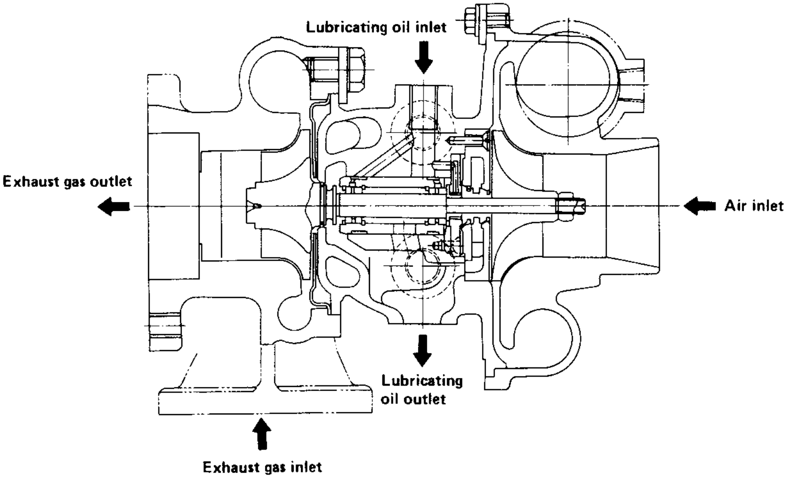
As an engine safeguard, in case of a boost control system failure, the ECM will switch off the fuel pump if boost pressure in excess of 0.92 bar (13.5 lb/in$^2$) is detected for more than 0.5 second.

The turbocharger bearings are supplied with an oil feed from the oil gallery at the right hand side of the block, and an oil drain is provided to return oil to the right hand side of the crankcase. In order to help protect the lubricant in the turbocharger bearings from the effects of heat soak after the engine has been stopped, a water feed and return system is provided, and connected between the thermostat housing and the radiator by-pass water pipe. Water circulation around the bearings continues after engine switch off, by thermo-syphon action,

## Turbocharger - External


Lubricating oil inlet
Coolant inlet
Coolant outlet
Air inlet
Exhaust gas outlet
Lubricating oil outlet
Exhaust gas inlet
Waste gate valve assembly
Air outlet

## Turbocharger - Cross Section


Lubricating oil inlet
Exhaust gas outlet
Air inlet
Lubricating oil outlet
Exhaust gas inlet

and reduces the possibility of carbonisation of the oil in the turbocharger.

The turbocharger unit is, with the exception of the wastegate capsule, a non-serviceable item which must be renewed if faulty. A certain amount of free play in the shaft bearings is a design feature, and should cause no concern unless the amount of play allows the turbine or compressor wheels to contact any part of their housings. The shaft should turn freely and smoothly and the turbine and compressor blades should be free form signs of mechanical damage. Note that great care must be taken when working on the engine to prevent any foreign bodies from entering the turbocharger or the blades will be severely damaged.

To Remove Turbocharger

1. Disconnect or remove the oxygen sensor.
2. Remove the turbocharger and starter catalyst heat shields.
3. Disconnect the compressor intake and outlet hoses.
4. Disconnect the oil feed pipe and return hose.
5. Disconnect the water feed and return hose. Release the water return pipe bracket from the exhaust manifold.
6. Disconnect the vacuum solenoid valve hose from the compressor spigot.
7. Unbolt the starter catalyst from the turbocharger, and remove each stud.
8. Unbolt the turbocharger from the exhaust manifold and withdraw.

Reverse the removal procedure to refit the turbocharger.

Wastegate Checking Procedure

To check that the wastegate capsule is operating correctly, proceed as follows:

Tools Required:
- Dial gauge
- Attachment finger T000T1102
- Hand operated vacuum/pressure pump T000T0907
- 0 - 20 psi pressure gauge (e.g. Mityvac 6810B)

1. Remove the turbocharger heatshield by releasing the three fixing screws.

2. Fit the attachment finger T000T1102 to the capsule rod and tighten the fixing screw. Fix the dial gauge parallel to the capsule rod and abutting the finger. Zero the gauge.

3. Disconnect the capsule pressure hose, and connect the hand pump and a suitable pressure gauge to the capsule as shown in the diagram.

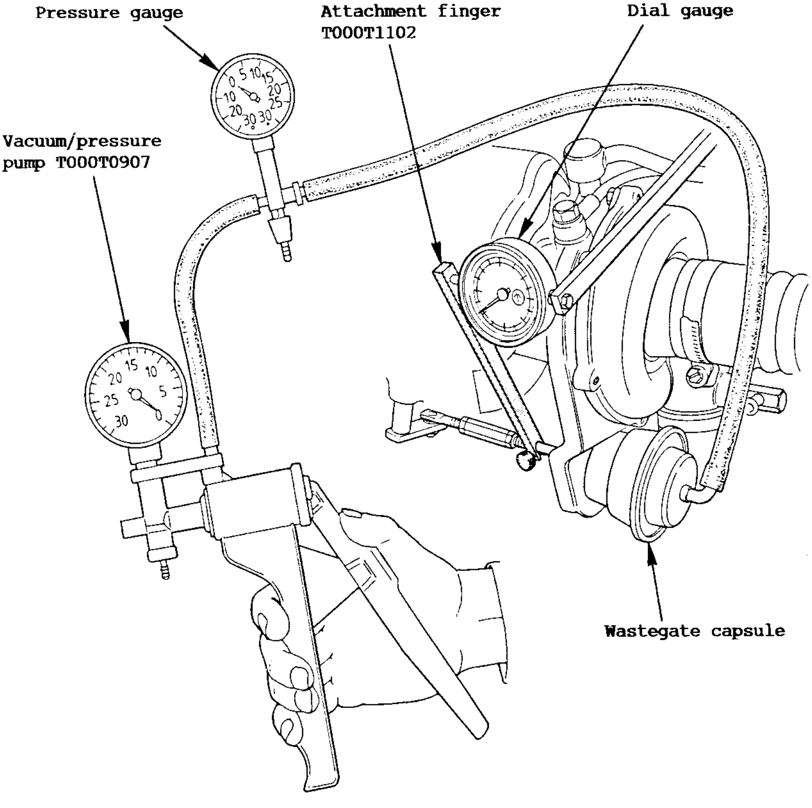
4. Use the hand pump to slowly increase pressure in the capsule, until the rod has moved 2mm. Record the pressure reading.
   **Specification:**
   Pressure on rise to produce 2mm rod movement = 9.8 - 10.2 lb/in$^2$

   Note that as the pressure is increased, a small amount of creep may occur before 'crack off' when the rod starts to move rapidly. If the 2mm point is overshot, release all pressure and begin again, as hysteresis in the system results in different results for increasing and decreasing pressures.

5. If specification is not achieved, small deviations on early cars may be corrected by an adjustment to the actuator rod length, but later cars with fixed length rods should have the capsule and rod assembly replaced.

6. To replace the wastegate capsule, release the actuator rod from the wastegate

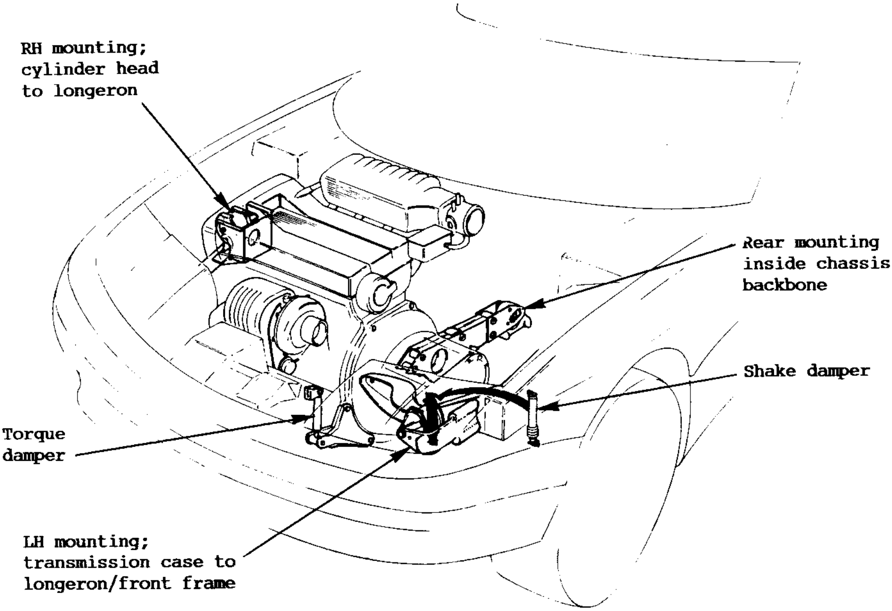
lever after removing the 'C' clip, and remove the three screws securing the capsule bracket to the turbocharger. Fit the new capsule and tighten the bracket fixings to 5 Nm. Retain the rod to the wastegate lever with the 'C' clip, and reconnect the pressure hose. Refit the heat shield.


Pressure gauge
Attachment finger T000T1102
Dial gauge
Vacuum/pressure pump T000T0907
Wastegate capsule

EC.15 - ENGINE MOUNTINGS

The engine is secured in the chassis by three widely spaced, voided rubber mounting bushes, and is provided with both torque and shake hydraulic dampers to further aid refinement and reduce noise vibration and harshness transmitted to the cabin.

- The right hand end of the engine is supported by a mounting bolted to the top of the right hand longeron.
- A bracket bolted to the front of the transmission casing carries a mounting which connects to the left hand longeron.

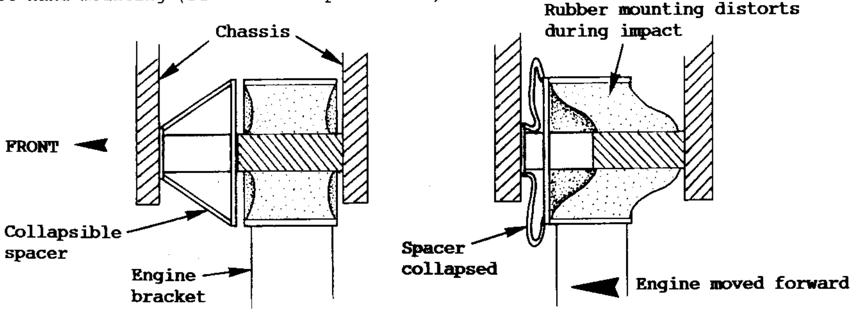

RH mounting; cylinder head to longeron
Rear mounting inside chassis backbone
Shake damper
Torque damper
LH mounting; transmission case to longeron/front frame

- An engine steady arm bolted to the rear of the engine/clutch housing, projects inside the front of the chassis backbone, and is secured via a rubber mounting to the chassis floor.
- An engine torque hydraulic damper is connected between a bracket bolted to the left hand front of the engine/clutch housing, and the underframe (Dom/Exp) or chassis front frame (USA).
- An engine shake damper is fitted across the left hand engine mounting.

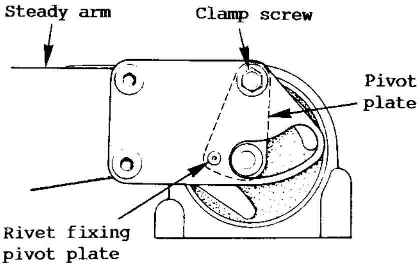
Collapsible Spacers (USA models)

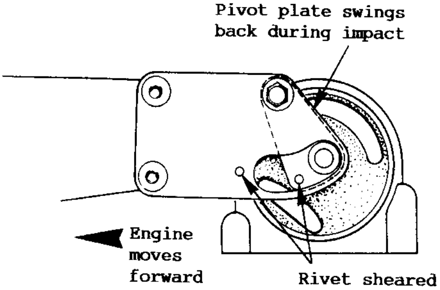
On USA cars, each of the three engine mountings is provided with a collapsible element designed to allow the engine to move forward on initial impact in a frontal collision. The chassis is then able to absorb the crash energy in a more progressive manner for optimum occupant protection.

The right and left hand engine mountings are fitted with collapsible spacers either behind the right hand mounting (fixed to the chassis), or ahead of the left hand mounting (fixed to the power unit).


Chassis
FRONT
Collapsible spacer
Engine bracket
Rubber mounting distorts during impact
Spacer collapsed
Engine moved forward

The rear mounting uses a slotted pivot plate retained by a clamp screw and rivet, where the rivet is designed to shear in an accident and allow the forward movement of the engine.


Steady arm
Clamp screw
Pivot plate
Rivet fixing pivot plate


Pivot plate swings back during impact
Engine moves forward
Rivet sheared

If the vehicle is to be repaired following a frontal collision, it is essential that all three of these collapsible elements are carefully inspected and replaced if there are any signs of collapse.

Engine Mounting Setting Procedure

When fitting an engine, the following procedure should be used to ensure that no preload is applied to the mountings in the static condition:

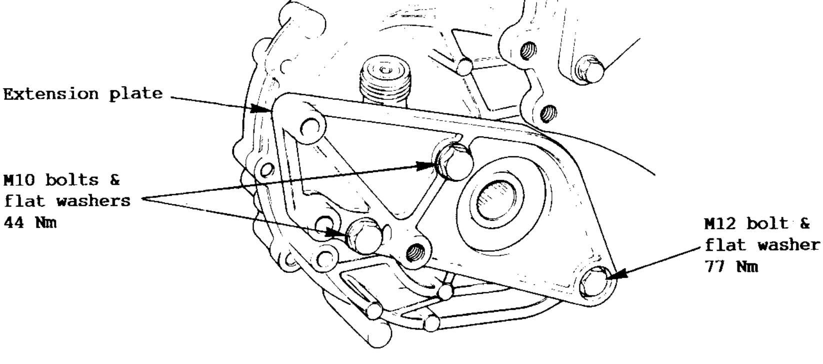
1. Before fitting the engine, assemble the rear steady arm and mounting: Three types of steady arm have been used:

i) A fabricated steel arm incorporating the engine mounting bush. This type used on early non-USA cars.

ii) A fabricated steel arm using impact shear pivot plates to pick up the mounting secured in a cast aluminium trunnion. Used on all USA cars and some non-USA cars.

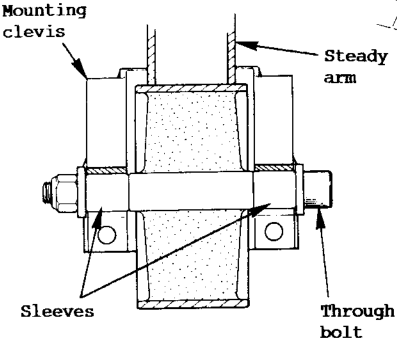
iii) A cast aluminium arm which incorporates the (previously separate) alloy extension plate bolted to the transmission. This type uses the impact shear plates as on (ii) but is NOT used on USA cars.

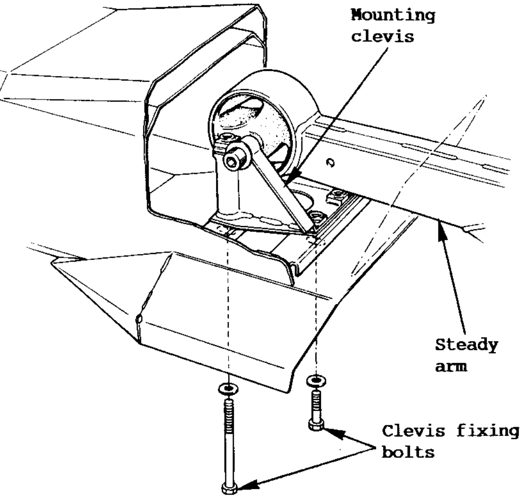
With type (i), check that the aluminium extension plate is securely fitted to the transmission.


Extension plate
M10 bolts & flat washers 44 Nm
M12 bolt & flat washer 77 Nm

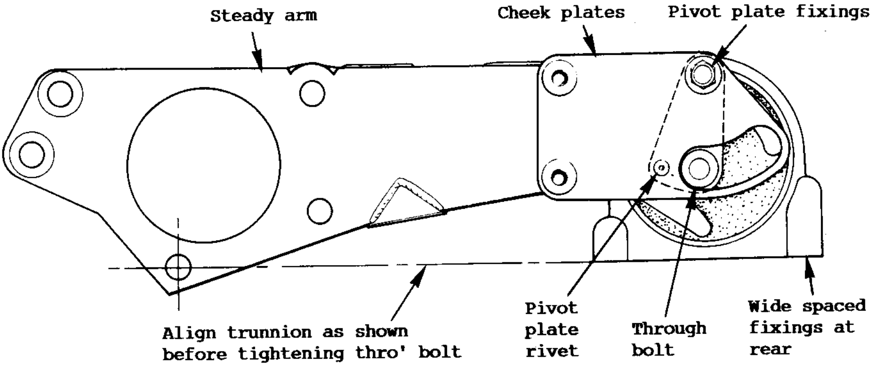
Fit the mounting clevis to the rubber bush in the steady arm as shown in the diagram, with the clamping towers towards the rear, and the sleeves and flat washers on the mounting through bolt. Torque tighten the through bolt to 75 Nm (55 lbf.ft). Fit the arm into the chassis, and locate the clevis with its four bolts but do not tighten.

Plan section of clevis & bush


Mounting clevis
Steady arm
Sleeves
Through bolt

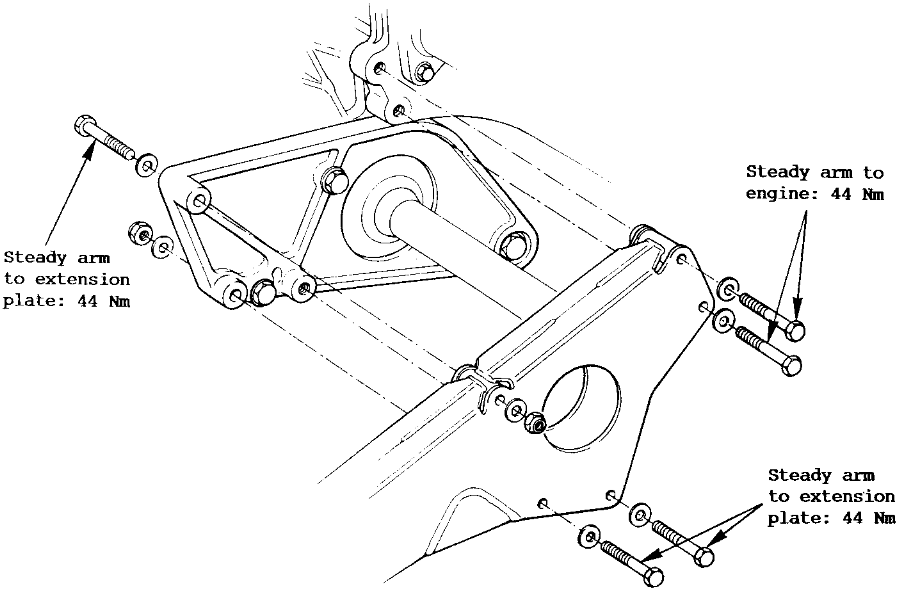

Mounting clevis
Steady arm
Clevis fixing bolts

With type (ii), check that the aluminium extension plate is securely fitted to the transmission. Check that the steady arm pivot plate rivets are intact; if not, renew the pair of cheek plate assemblies and secure to the steady arm with the four button head screws (apply thread locking compound e.g. Permabond A115), torque tightening to 45 Nm (33 lbf.ft). Do not disturb the pivot plate nuts which are set during manufacture. Assemble the mounting trunnion to the pivot plates (wide spaced fixings to the rear) and torque tighten the through bolt to 75 Nm (55 lbf.ft) with the arm and trunnion positioned as shown in the diagram. Fit the arm assembly into the chassis, and locate the trunnion with its four bolts, but do not tighten.

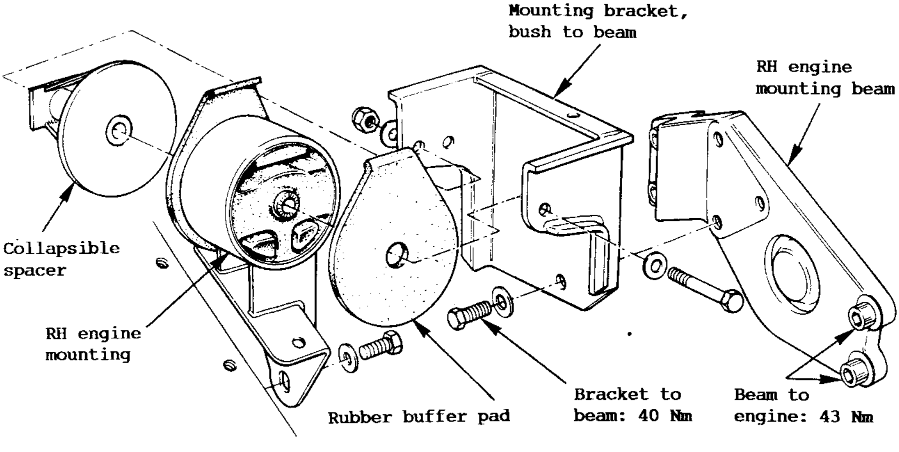

Steady arm
Cheek plates
Pivot plate fixings
Align trunnion as shown before tightening thro' bolt
Pivot plate rivet
Through bolt
Wide spaced fixings at rear

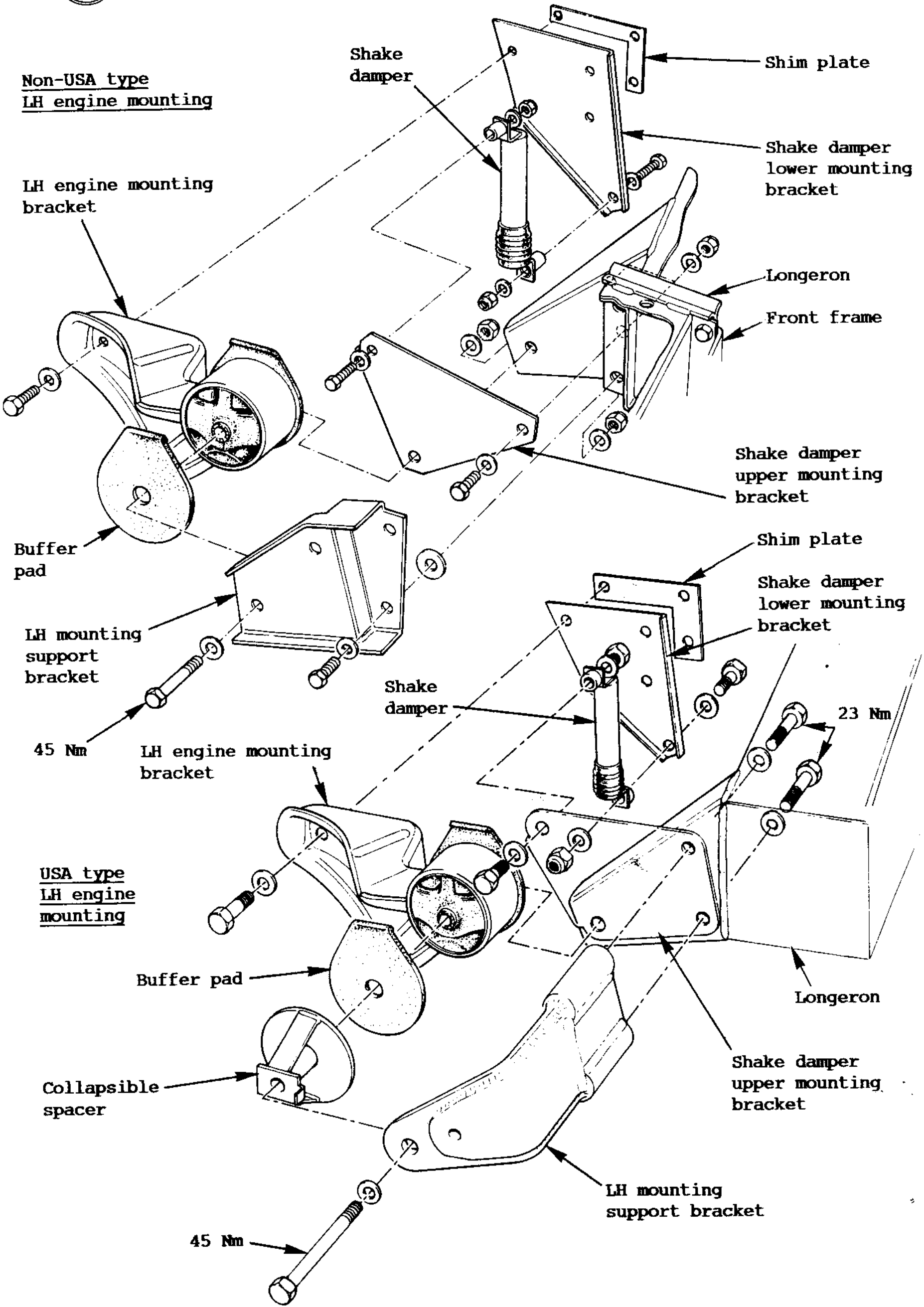
Assembly of type (iii) is as for (ii), except that the transmission housing extension plate is not fitted.

2. With the engine supported in position, fit the steady arm to the engine/transmission and torque tighten all fixings.


Steady arm to extension plate: 44 Nm
Steady arm to engine: 44 Nm
Steady arm to extension plate: 44 Nm

3. Fit the right hand engine mounting assembly with the rubber buffer pads fitted each side of the mounting. Fit the collapsible spacer behind the mounting on USA cars, ensuring that the tang on the spacer is engaged in the mounting bracket hole. Torque tighten all fixings.


Mounting bracket, bush to beam
RH engine mounting beam
Collapsible spacer
RH engine mounting
Rubber buffer pad
Bracket to beam: 40 Nm
Beam to engine: 43 Nm



Non-USA type LH engine mounting

Shake damper
Shim plate
Shake damper lower mounting bracket
LH engine mounting bracket
Longeron
Front frame
Shake damper upper mounting bracket
Buffer pad
LH mounting support bracket
45 Nm

USA type LH engine mounting

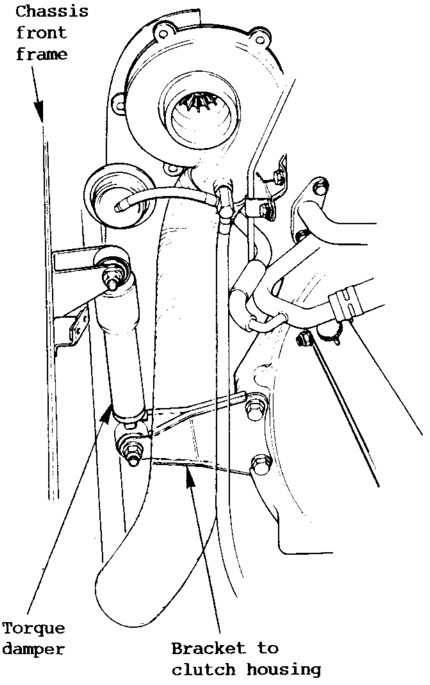
Shim plate
Shake damper lower mounting bracket
Shake damper
23 Nm
LH engine mounting bracket
Buffer pad
Longeron
Collapsible spacer
Shake damper upper mounting bracket
LH mounting support bracket
45 Nm

4. Fit the left hand mounting bracket and shake damper bracket to the transmission case. Check that the rubber buffer pads are fitted each side of the mounting before assembling the through bolt and chassis bracket. On USA cars, fit the collapsible spacer ahead of the mounting, and check that the tang on the spacer is engaged in the chassis bracket hole. As these fixings are tightened, assess any fore/aft preload being applied to the mounting bush, after allowing movement of the power unit to the extent provided by the rear mounting slots in the chassis. If necessary, i) fit spacer shim plates (max 3) between the mounting bracket and transmission case to space the mounting forward, or ii) fit a spacer washer between the mounting and chassis, together with similar thickness washers between the mounting bracket and chassis, to space the mounting forward.

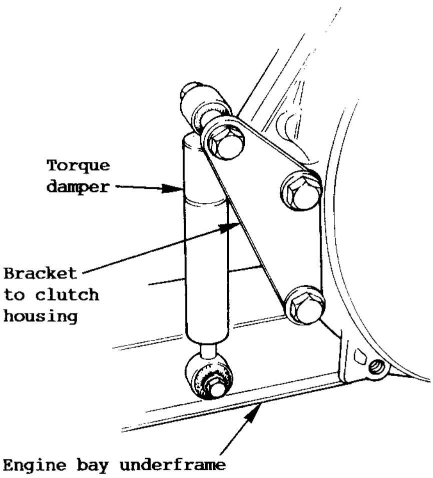
5. Tighten the four bolts securing the rear mounting to the chassis tunnel floor to 23 Nm (17 lbf.ft).

6. Fit the shake and torque dampers.

**USA Type Torque Damper**


Chassis front frame
Torque damper
Bracket to clutch housing

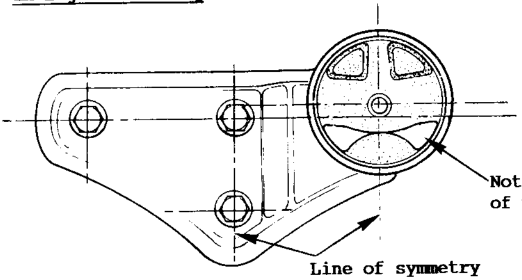
**Non-USA Type Torque Damper**


Torque damper
Bracket to clutch housing
Engine bay underframe

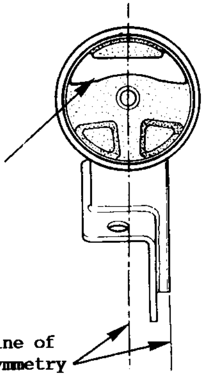
Mounting Bush Replacement

The three engine mounting bushes are of similar physical dimensions, but differ in the construction of the rubber bush. Each bush may be removed from its mounting bracket using a hydraulic press. Before pressing a new bush into position, take care to ensure that the correct bush is selected, and that it is correctly orientated.

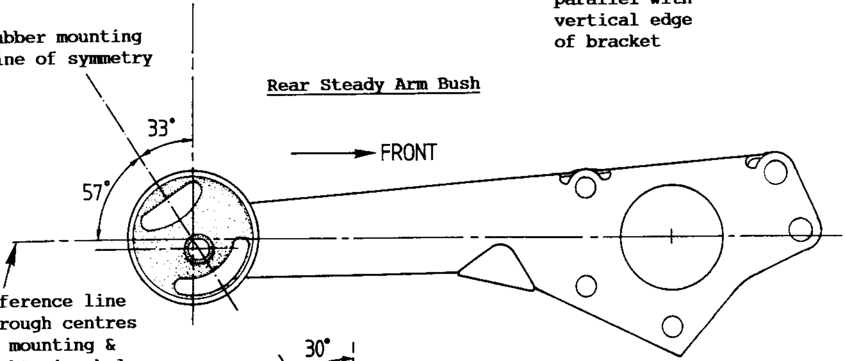
**LH Engine Mounting**


Line of symmetry parallel with vertical through 2 mounting bolt holes
Note shape of void

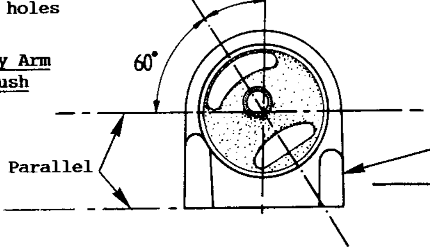
**RH Engine Mounting**


Line of symmetry parallel with vertical edge of bracket

**Rear Steady Arm Bush**


Perpendicular to reference line
Rubber mounting line of symmetry
33°
57°
FRONT
Reference line through centres of mounting & lightening holes

**Rear Steady Arm Trunnion Bush**


30°
60°
Parallel
FRONT
Note that fixing holes at front of trunnion are closer together

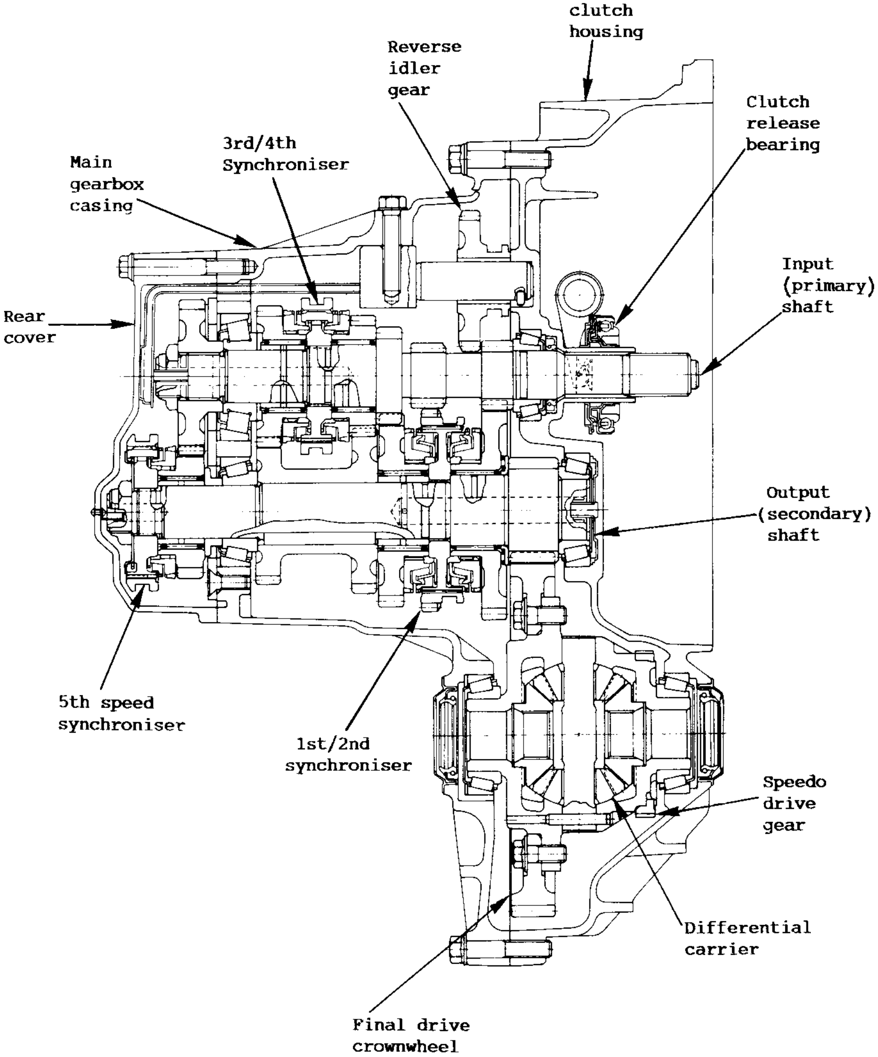
## EC.16 - SPECIAL TOOLS

| **Description** | **Part Number** |
|---|---|
| Vacuum/Pressure Pump. Used to check turbo wastegate opening pressure. | T000T0907 |
| Blanking Plug, transmission output shaft. Reduces transmission oil loss when a driveshaft has been removed. | T000T1014 |
| Installer, camshaft front oil seal. Enables oil seal to be fitted without damage. | T000T1015 |
| Valve Spring Compressor. Permits removal of the split collets from two valve stems at the same time. | T000T1016 |
| Valve Guide Drift. Used to remove and refit inlet and exhaust valve guides. | T000T1017 |
| Replacer, valve stem oil controller. Permits replacement of valve stem oil controller on valve guide. | T000T1018 |
| Seal Cutter, sump joint. Used with a hammer to cut the sealant between sump and block. | T000T1019 |
| Oil Filter Wrench. Eases removal of engine oil filter. | T000T1020 |
| Installer, crankshaft front oil seal. Enables fitment of crank seal in oil pump housing. | T000T1021 |
| Piston Pin Service Set. Used only on N.A. to remove/refit piston pin. (Turbo is push fit) | T000T1022 |
| Installer, crankshaft rear oil seal. Permits fitment of crank rear oil seal in rear seal housing. | T000T1024 |
| Attachment Finger, dial gauge operating. Clamps onto wastegate capsule rod and operates dial gauge plunger. | T000T1102 |

# TRANSMISSION

## SECTION FF - M100

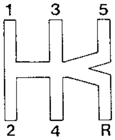
| | Sub-Section | Page |
|---|---|---|
| Main Data | FF.1 | 3 |
| General Description | FF.2 | 3 |
| Lubrication | FF.3 | 4 |
| Gearchange Cable Adjustment | FF.4 | 5 |
| Gearchange Cable & Gearlever Mechanism Replacement | FF.5 | 6 |
| Transmission Assembly Removal | FF.6 | 9 |
| Transmission Assembly Replacement | FF.7 | 10 |
| Major Component Disassembly | FF.8 | 11 |
| Major Component Assembly | FF.9 | 16 |
| Input & Output Shaft Disassembly/Assembly | FF.10 | 25 |
| Final Drive Disassembly/Assembly | FF.11 | 31 |
| Selector Housing Disassembly/Assembly | FF.12 | 34 |
| Driveshafts | FF.13 | 35 |
| Fault Diagnosis | FF.14 | 39 |
| Special Tools | FF.15 | 40 |


clutch housing
Reverse idler gear
Clutch release bearing
3rd/4th Synchroniser
Main gearbox casing
Input (primary) shaft
Rear cover
Output (secondary) shaft
5th speed synchroniser
1st/2nd synchroniser
Speedo drive gear
Differential carrier
Final drive crownwheel

## FF.1 - MAIN DATA

| | |
|---|---|
| Total Length | 348.5 mm |
| Weight | 36.5 kg |
| Lubricant (5W-30) | Mobil 1 RTS 9775 Fully Synthetic |
| Lotus part number | A100F6036V |
| Capacity | 1.9 litres |
| Gear ratio - 1st | 3.333:1 (40/12) |
| 2nd | 1.917:1 (46/24) |
| 3rd | 1.333:1 (40/30) |
| 4th | 1.027:1 (38/37) |
| 5th | 0.829:1 (34/41) |
| Reverse | 3.583:1 (43/12) |
| Final drive ratio - N.A. | 4.118:1 (70/17) |
| - Turbo | 3.833:1 (69/18) |
| Speedometer gear ratio | 0.829:1 (29/35) |
| Identification on 'bar code' label - N.A. | LAA |
| - Turbo | LAB |

Shift pattern



## FF.2 - GENERAL DESCRIPTION

The transmission assembly is an 'end on' type, mounted on the left hand end of the engine unit, and comprises of the clutch housing, five speed gearbox, final drive gears, and differential.

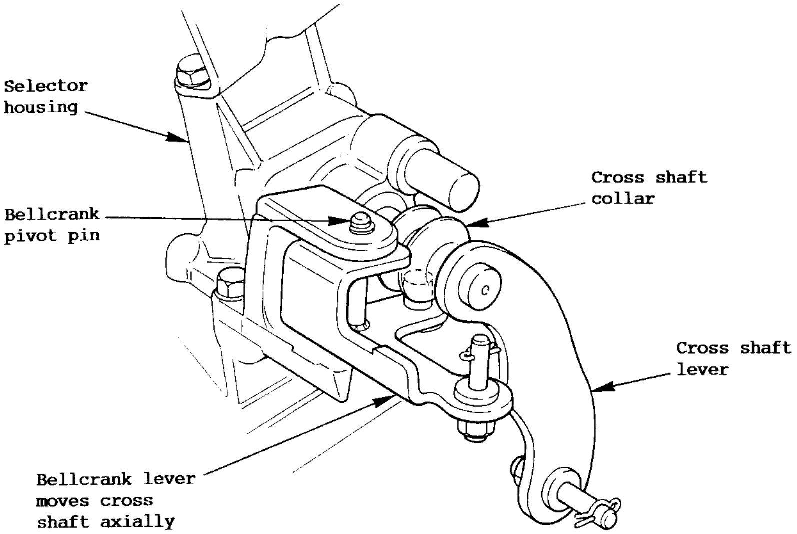
### Gearbox

The gearbox is a two shaft all indirect five speed manual. Drive passes into the unit via the primary shaft which is co-axial with the engine crankshaft, and carries the clutch driven plate on its right hand end. A secondary shaft lying alongside and behind the primary shaft, outputs the drive via an integral final drive pinion on its right hand end. This pinion meshes with a crownwheel carried on a bevel gear differential assembly, which distributes drive to the front wheels via two C.V. jointed driveshafts. Use of an output shaft jackshaft on the right hand side, enables the two driveshafts to be of similar length to reduce the effects of torque steer.

Sychromesh is fitted to all forward speeds, with the 1st/2nd synchroniser mounted on the secondary shaft, the 3rd/4th synchroniser on the primary shaft, and the 5th synchroniser on the 'overhung' left hand end of the secondary shaft. Reverse gear is achieved by sliding an idler spur gear into engagement with both a drive gear integral with the primary shaft, and the spur gear teeth machined on the outside of the 1st/2nd synchroniser assembly. The primary shaft, secondary shaft and differential carrier are all supported on pairs of taper roller bearings adjusted by shims. The speedo drive gear is mounted on the differential carrier.

### Gearchange Mechanism

Four selector shafts lie across the top of the gearbox, and are operated by a cross shaft with a single actuating finger. A series of interlock plungers between the shafts allow only one selector shaft to be moved from the neutral position at any one time. The cross shaft is housed in a selector housing on top of the transmission housing, and is fitted with a lever by which the shaft may be rotated to engage a gear, and a collar which is used to move the shaft axially (endways) for crossgate selection.



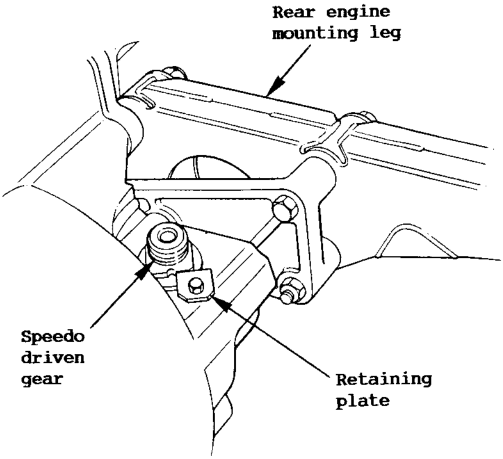
The gearchange lever is connected to the transmission by two control cables, and is spring biased by the cross shaft to the 3rd/4th gear plane. The lever must be moved against light spring pressure to the left to engage 1st or 2nd gear, or against similar pressure to the right to engage 5th or reverse gear. A reverse inhibitor stopper cam in the control box, prevents selection of reverse gear directly from fifth, by requiring that the lever is first moved across the neutral gate to release an interlock.

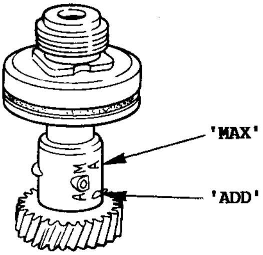
## FF.3 - LUBRICATION

It is most important to use only the lubricant specified: Mobil 1 RTS 9775 fully synthetic.

At specified service intervals, the transmission should be thoroughly checked for any signs of oil leakage, evidenced by oil staining or wetness around a joint line or oil seal, and the oil level checked.

To check the oil level, or to refill or add lubricant, the speedo driven gear assembly must be removed, and the oil level indication on the plastic bushing inspected. Check the oil level only with the engine off, and the transmission cool enough to enable the casing to be touched by hand. The speedo driven gear is located at the rear of the differential housing and is accessible from above. Withdraw the speedo driven gear assembly with the cable attached, after releasing the single screw securing the retaining plate. Add the recommended lubricant until the level is midway between the high and low marks on the speedo gear bush. Refit the retaining plate and tighten the fixing screw to 6 Nm (4.5 lbf.ft)

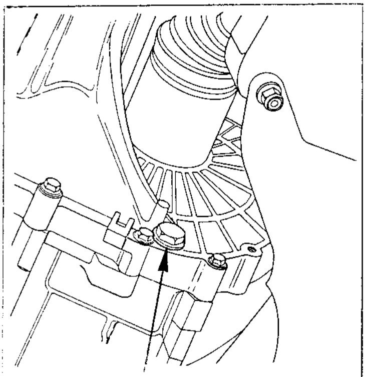




Drain the transmission oil immediately after a run, when the oil is warm and the impurities are held in suspension. Remove the drain plug from the left hand side of the final drive housing, beneath the output shaft.

Allow the oil to drain thoroughly before replacing the plug (with a new washer if necessary), and tightening to 39 Nm (29 lbf.ft).

Oil capacity:
1.9 litres (3.3 imp.pt; 4.0 U.S.pt)

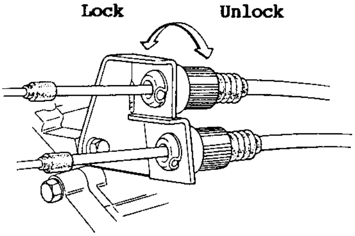

Transmission drain plug

## FF.4 - GEARCHANGE CABLE ADJUSTMENT

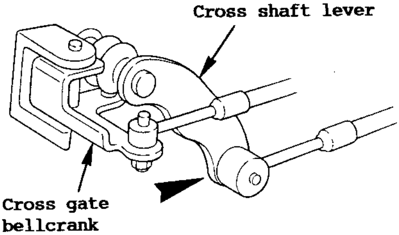
The gearchange mechanism uses two control cables to transmit the motion of the gearchange lever to the gearbox cross shaft. One cable connects directly to the bottom of the gearshift lever and transmits fore/aft motion to the gearbox cross shaft lever. A second, 'crossgate' cable, is connected to a bellcrank lever at the base of the shift lever assembly, and transmits crossways movement of the lever to another bellcrank lever at the selector housing. This bellcrank engages with a collar on the cross shaft, and moves the shaft axially.

### Adjustment

Each of the cables is fitted with a quick adjustment locking sleeve at the gearbox end. By turning the outer sleeve by a quarter turn, the cable outer can be allowed to slide freely within the sleeve, or be locked to it. To adjust the two gearchange cables, proceed as follows:



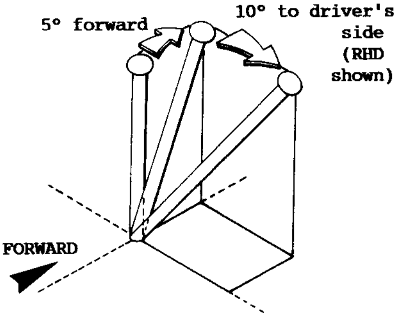
1. With the gearchange cables fitted and connected, unlock the adjuster sleeve on each cable at the gearbox abutment bracket, by turning the outer sleeve **against** the direction of the arrow (top of the sleeve to the rear).



2. Set the transmission in third gear by moving the cross shaft lever (spring biased to the 3rd/4th gear plane) to the right.

3. Position the gear lever leaning 5° forward, and 10° towards the driver's side and hold in this position whilst the adjuster sleeves are locked by turning in the direction of the arrow.

4. Check the selection of all gears.



FF.5 - GEARCHANGE CABLES & GEARLEVER MECHANISM REPLACEMENT

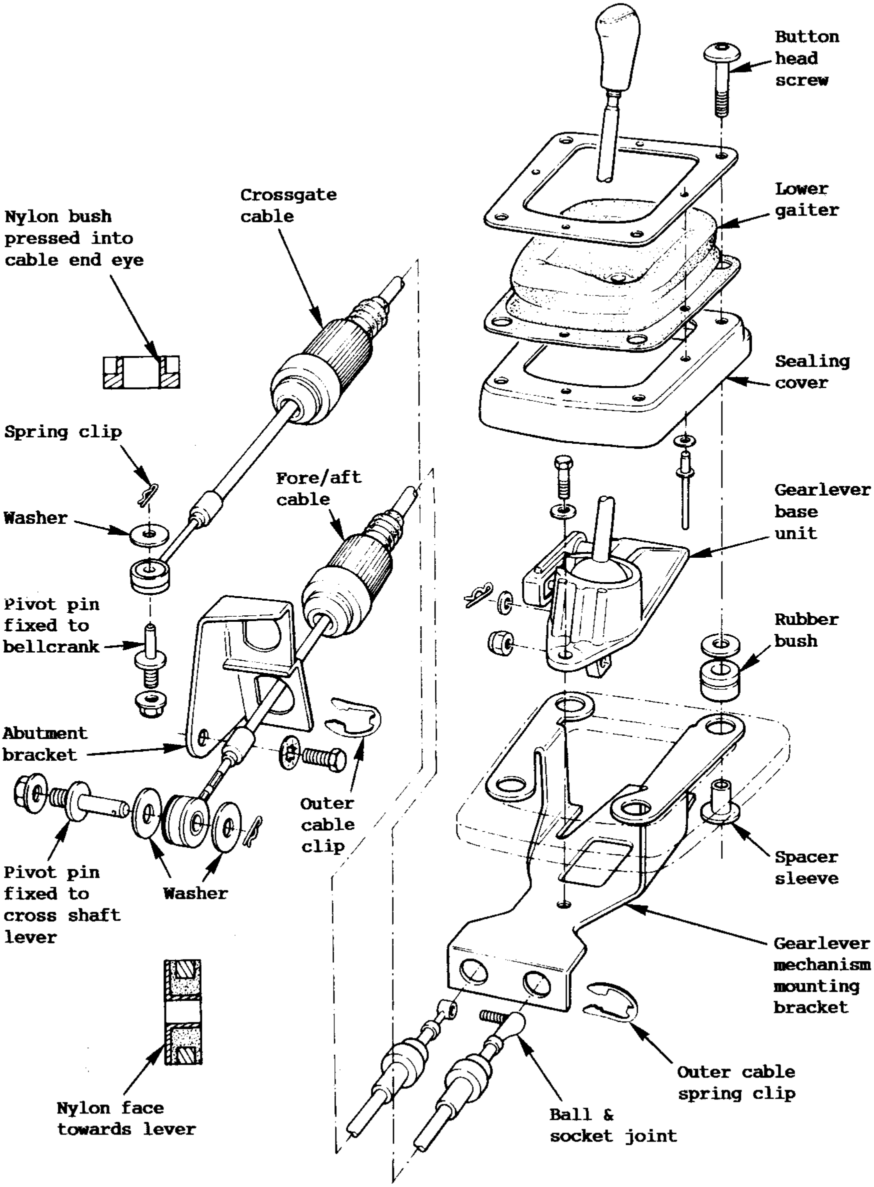
The gearlever mechanism must be withdrawn into the car, in order to provide access to the cable rear abutment and permit cable replacement.

To Remove

1. Gearchange Cables: Pull off the spring clips securing the two inner cables to the gearbox levers, and the spring clips securing the adjuster sleeves to the abutment bracket. Release the cables from the gearbox, taking care to note the positions of the washers for the inner cable eyes.

2. Gear Lever Knob: To remove the knob, push down the top of the gaiter from its location groove in the underside of the knob, and slacken the grub screw exposed. Turn the knob counterclockwise to unscrew from the gear lever.

3. Centre Tunnel Console & Trim Gaiter:
- Remove the filler panel from between the rear of the centre tunnel console and the rear wall, by releasing the single retaining screw.
- Pull out and disconnect the mirror control switch, to the rear of the gear lever.
- Pull out and disconnect the two window switches, each side of the parking brake lever, and release the two console front fixing screws via the switch apertures.
- Pull out the oddments tray from the rear of the tunnel top, and release the two console rear fixings via the tray aperture. Pull the console to the rear to


Nylon bush pressed into cable end eye
Crossgate cable
Spring clip
Washer
Fore/aft cable
Pivot pin fixed to bellcrank
Abutment bracket
Outer cable clip
Pivot pin fixed to cross shaft lever
Washer
Nylon face towards lever
Button head screw
Lower gaiter
Sealing cover
Gearlever base unit
Rubber bush
Spacer sleeve
Gearlever mechanism mounting bracket
Outer cable spring clip
Ball & socket joint

disengage the tongues from the main fascia, and then lift the console over the parking brake lever.

- Remove the gear lever gaiter over the lever.

4. Lower Gaiter & Gearchange Mechanism: Remove the four button head screws securing the lower gaiter assembly, and gearchange mechanism to the chassis. Pull the lower gaiter assembly up off the gearlever, and withdraw the lever assembly from the chassis aperture, complete with the cables. Do not misplace the alloy spacer sleeves from each of the gearlever assembly rubber mountings.

5. Gearchange Cables: Release the crossgate cable from the gearlever bellcrank by removing the spring clip and washer. Disconnect the fore/aft cable by removing the retaining nut. Pull off the spring clip securing each of the outer cables to the gearlever bracket.

6. Gearlever Assembly: Further dismantle the gearlever mechanism if necessary.

To Replace

1. Gearlever Assembly: If necessary, re-assemble the gearlever assembly, and refit to the gearchange bracket, torque tightening the two screws to 15 Nm (11 lbf.ft).

2. Fore/Aft Gearchange Cable: The fore/aft cable may be identified by the rubber bushed eye at the front end, and the ball joint threaded spigot at its rear end. Fit the rear end of the cable through the left hand abutment hole in the gearchange mechanism bracket, ensuring that the flat on the outer cable spigot is properley located in the 'D' hole, and secure with an 'E' clip (A100F 6291F) with the concave side towards the abutment bracket. Discard any spring wire type clip fitted previously . Fit the inner cable threaded spigot to the bottom of the gear lever and secure with the nyloc nut.

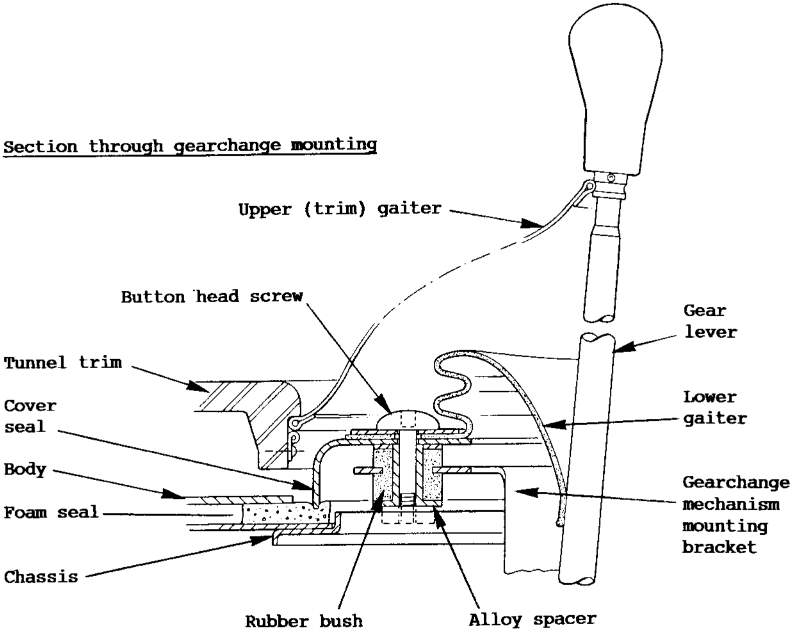
3. Crossgate Cable: The crossgate cable has a small eye at each end. Fit the rear end of the cable (end without the quick adjuster sleeve) through the right hand abutment hole in the gearchange mechanism bracket, ensuring that the flat on the outer cable spigot is properley located in the 'D' hole, and secure with an 'E' clip (A100F6291F) with the concave side towards the abutment bracket. Discard any spring wire type clip fitted previously. Fit the inner cable eye onto the bellcrank lever spigot, (using PBC grease) with the nylon face of the bush against the lever, and retain with the washer and spring clip.

4. Gearchange Mechanism: Feed the cables into the chassis aperture, and out into the engine bay whilst fitting the gearchange mechanism into position. Check that a rubber bush is fitted in each of the bracket mounting holes, with the larger portion of the bush on the underside of the bracket. Fit an aluminium spacer into each bush from the underside, and position the four holes over the weldnuts on the chassis. Fit the lower gaiter assembly (moulded plastic base, rubber gaiter and steel top plate rivetted together) over the gearlever, and into position over the four fixing holes. Fit the four button head fixing screws, and tighten to 22.5 Nm (17 lbf.ft). Ensure that the centre of the rubber grommet is pushed down the shaft of the gear lever, rather than pointing upwards.

5. Trimmed Gaiter & Tunnel Console: Fit the trimmed gaiter over the gear lever, and locate the wired base of the gaiter into its location in the fascia moulding. Refit the tunnel console in the reverse order to disassembly.

6. Gear Lever Knob: Screw the knob onto the lever, and secure by tightening the

Section through gearchange mounting


Upper (trim) gaiter
Button head screw
Gear lever
Tunnel trim
Cover seal
Lower gaiter
Body
Gearchange mechanism mounting bracket
Foam seal
Chassis
Rubber bush
Alloy spacer

grub screw. Pull the top of the trim gaiter upwards to locate in the knob groove.

7. Gearbox End: Fit the crossgate cable (smaller eye) through the top hole in the abutment bracket, and fit the inner cable onto the bellcrank lever spigot with the nylon face against the lever. Retain with the washer and spring clip. Retain the outer adjuster sleeve (with 'D' fully engaged) to the abutment bracket with an 'E' clip (A100F6291F) with the concave side towards the abutment bracket. Discard any spring wire type clip fitted previously.

Fit the fore/aft cable in a similar manner into the lower hole, but note that a washer is fitted on each side of the rubber bushed eye of the inner cable when fitting to the cross shaft bellcrank. Apply PBC grease to all pivot pins.

8. Adjustment: Adjust the cables as detailed in section FF.4.

## FF.6 - TRANSMISSION ASSEMBLY REMOVAL

The transmission assembly may be removed from beneath the vehicle, after removing the underframe.

1. Preparatory: Drain the transmission oil. Remove both front road wheels and both front hub nuts.

2. Engine Bay: Remove or disconnect the following items;
- Release the air filter box mounting bracket from the LH longeron, disconnect the hoses and boost solenoid valve wires, and remove the air filter assembly.
- Disconnect the speedo cable and reverse switch wires.
- Unhook the clutch cable from the lever arm, and release the outer cable from

its abutment bracket.
- Release both gear change cables from their selector levers, pull off the spring clips retaining the outer cable quick adjusters to the transmission abutment plate, and remove the cables from the transmission.

3. Underframe: Remove the underframe by releasing:
- three bolts securing the front end of the underframe to the radiator support frame;
- two bolts each side securing the lower bushes of the suspension rafts;
- the single bolt at each side securing the rear of the underframe to the chassis front crossmamber;
- two bolts each side securing the tubular stays to the underframe;
- also remove the left hand stay from the chassis.

4. Driveshafts: Mark the position of the camber adjustment eccentrics on both RH and LH front suspension top wishbones, before releasing the two bolts securing the top wishbone halves to the top ball joint. Push the drive shafts out of the front hubs, and use a slide hammer with a forked end, or a lever between the body of each inboard C.V. joint and the transmission to 'shock' the driveshaft over the retaining circlip, and off output shaft. Leave the driveshaft suspended in the damper yoke.

5. Jackshaft: Remove the two bolts securing the jackshaft bearing bracket to the engine, and withdraw the shaft (note - no retaining circlip is used at this point).

6. Exhaust Downpipe: Disconnect the exhaust downpipe, and release the anti-roll bar from the drop links to allow the exaust to drop further.

7. LH Engine Mounting: Use a jack or sling to support the weight of the engine/transmission assembly before removing the left hand engine (transmission) mounting from the chassis. Remove the bracket from the transmission housing.

8. Rear Engine Mounting: Release the rear engine mounting arm from the transmission, and remove the aluminium mounting plate.

9. Flywheel Cover: Remove the flywheel lower cover from the engine and transmission.

10. Transmission Assembly: Lower the transmission end of the engine, and support the transmission assembly before removing the four bolts connecting the transmission to the engine, and withdraw the unit from the car, tilting the engine further if necessary, but taking care not to strain any hoses or harnesses.

## FF.7 - TRANSMISSION ASSEMBLY REPLACEMENT

Reverse the removal procedure, noting the following points:

- Before fitting the jackshaft, fit a new square section snap ring A100F6095H into the outboard end groove. Take care not to damage the output shaft oil seal when the jackshaft is inserted into the transmission.
- Before fitting the LH driveshaft into the transmission, fit a new round section snap ring A100R6001F onto the spigot of the inboard C.V. joint.
- After pressing both driveshafts into position, check that the circlip is

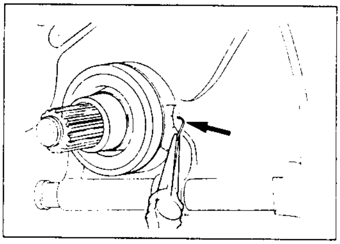
fully located in its groove by pulling on the body of the inboard joint.

- Ensure the camber adjustment eccentrics in the top wishbone are positioned as noted prior to removal.
- Do not forget to fit the brake hose into the top wishbone bracket, and retain with the spring clip.
- Refill the transmission using only Mobil 1 RTS 9775 (A100F6036V).

| Torque Figures | Nm | lbf.ft |
|---|---|---|
| Clutch Housing to Cylinder Block: | 90 | 66 |
| Alloy Mounting Plate to Transaxle - M10 | 44 | 33 |
| - M12 | 75 | 55 |
| Engine Mounting Arm to Alloy Plate - M10 | 44 | 33 |
| Engine Mounting Arm to Block - M12 | 75 | 55 |
| Jackshaft to Block | 38 | 28 |
| Damper Yoke to Lower Link | 75 - 80 | 55 - 59 |
| Top Wishbone to Ball Joint | 22 - 25 | 16 - 18 |
| Raft Top Mounting to Chassis | 75 - 80 | 55 - 59 |
| Sandwich Plate to Raft | 22 - 25 | 16 - 18 |
| Raft Front & Rear Mountings | 75 - 80 | 55 - 59 |
| Underframe to Stay | 75 | 55 |
| Stay to Chassis | 75 | 55 |
| Underframe to Radiator Support Frame | 10 | 7.5 |

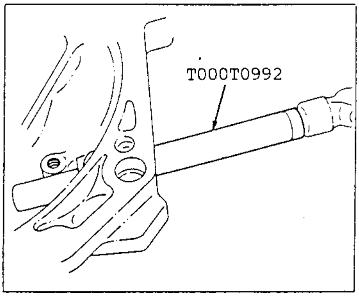
## FF.8 - MAJOR COMPONENT DISASSEMBLY

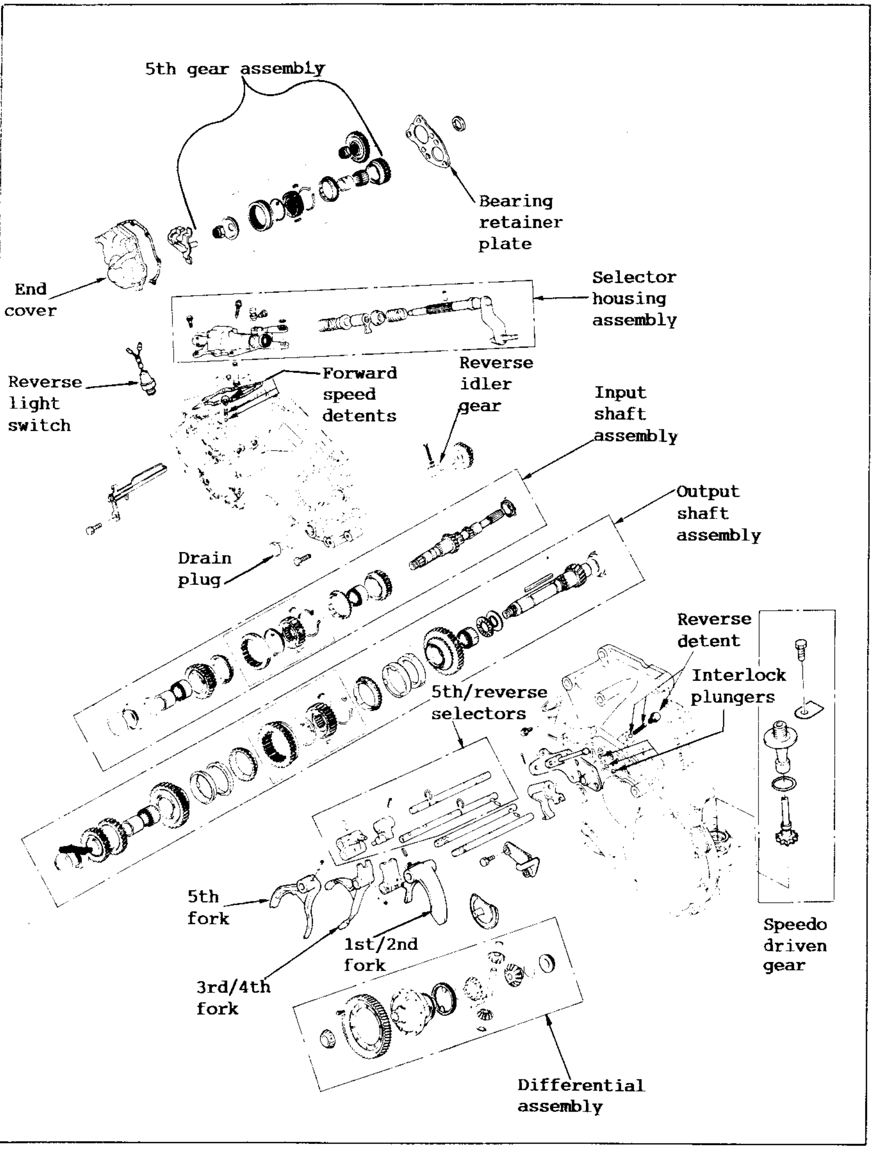
1. Clutch Release Bearing: Release the spring clip securing the clutch release bearing to the release fork, and withdraw the release bearing.



2. Clutch Release Fork & Shaft: If necessary, remove the clutch release fork and shaft. Remove the operating arm, pull off the dust cap, and prise out the clutch shaft seal. Use the special tool to knock the shaft bush along the shaft and into the housing. Unhook the shaft spring and withdraw the shaft from within the housing.

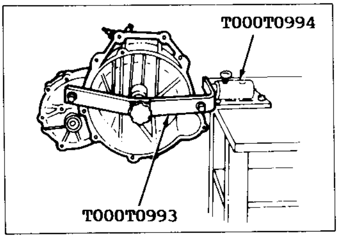
Clutch Shaft Bush Inserter/Replacer Tool - T000T0992




5th gear assembly
Bearing retainer plate
End cover
Selector housing assembly
Reverse light switch
Forward speed detents
Reverse idler gear
Input shaft assembly
Output shaft assembly
Drain plug
Reverse detent
Interlock plungers
5th/reverse selectors
5th fork
1st/2nd fork
3rd/4th fork
Speedo driven gear
Differential assembly

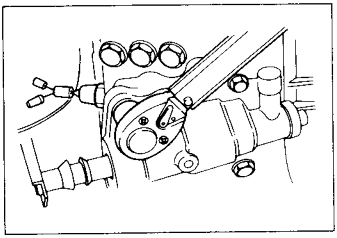
3. For ease and safety of working, mount the transmission assembly to a secure bench using special tools:

Holding fixture - T000T0993
Fixing base - T000T0994

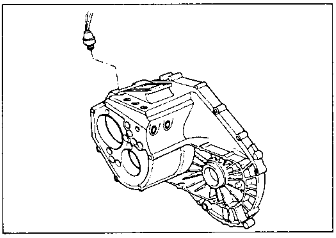


4. End Cover: Remove the 7 screws securing the end cover, and pull off the cover and gasket.

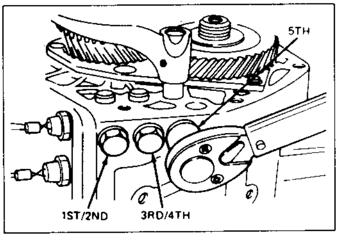
5. Selector Housing Assembly: Remove the 4 screws securing the selector housing, and remove the complete assembly and gasket.



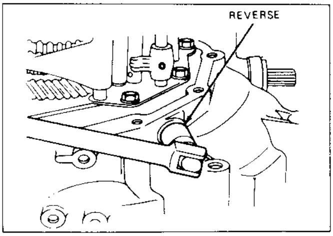
6. Reverse Light Switch: Unscrew and remove the reverse light switch and aluminium washer.



7. Detent Plugs, Balls & Springs: Remove the three plugs, and withdraw the detent springs and balls for the forward speed selector shafts.

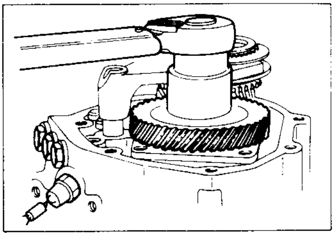


8. Reverse Detent: Remove the plug and withdraw the reverse selector shaft detent spring and ball.



9. 5th Fork Spring Pin: Use a pin punch to drive out the double roll pin securing the 5th selector fork to its shaft.

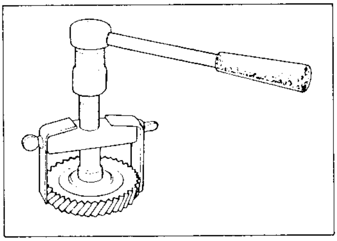
10. 5th Synchroniser Nut & 5th Drive Gear Nut: Engage 3rd or 4th gear by moving the 3rd/4th selector shaft with a screwdriver, and then engage 5th gear by sliding the 5th selector fork along its shaft. Having locked the transmission in this way, remove the nuts from both shafts (RH threads) and discard. Shift back into neutral.



11. 5th Synchro Assembly: Pull off from the output shaft the 5th synchroniser assembly complete with stop plate, shift fork and synchro ring.

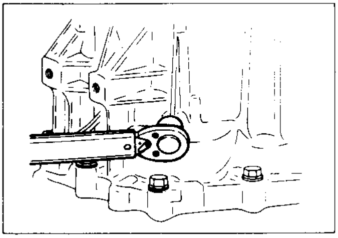
12. 5th Driven Gear: Lift off from the output shaft the 5th speed driven gear with its needle roller bearing.

13. 5th Drive Gear: Use a puller to withdraw the 5th speed drive gear from the input shaft. Note that recesses are provided in the bearing retainer plate for the puller legs.



Gear puller T000T0995

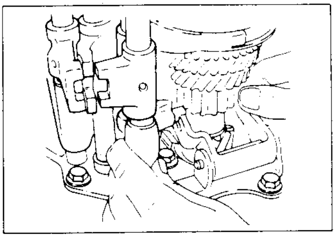
14. Idler Shaft Bolt & Washer: Remove the bolt and copper washer securing the reverse idler gear shaft.



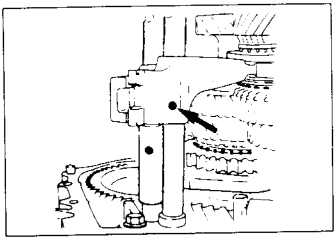
15. Gearbox Casing: Remove the 14 bolts securing the gearbox casing to the clutch/differential housing, and with the unit mounted vertically, lift off the gearbox casing.

16. Reverse Idler Gear & Shaft: Withdraw the reverse idler gear with its shaft, taking care not to misplace the shaft location pin.

17. Selector Shaft & Block Assembly, 5th & Reverse: Move the 5th selector shaft down into the 5th gear position, and remove the circlip from the 5th shaft below the operating block. Lift 5th selector shaft clear of the interlock plungers (do not lift right out of the operating block or the sliding pin inside the block may be lost), to allow the 5th and reverse selector shaft assemblies to be withdrawn together. Take care not to misplace the interlock pin from within the 5th shaft end.



18. Selector Shaft & Fork, 3rd/4th: Use a pin punch to remove the single roll pin securing the (steel) selector fork to the 3rd/4th selector shaft. Discard the roll pin. Slide the shaft upwards and remove the shaft and fork.
Take care not to misplace the interlock pin within the selector shaft.



19. Selector Shaft & Fork, 1st/2nd: Use a pin punch to remove the roll pin securing the (alloy) selector fork to the 1st/2nd selector shaft. Discard the roll pin. Slide the shaft upwards and remove the shaft and fork.

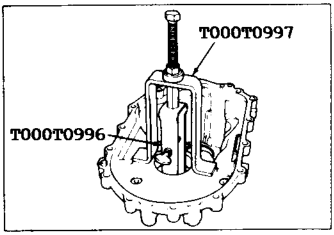
20. Input & Output Shaft Assemblies: Withdraw the input and output shaft assemblies.

21. Differential Assembly: Withdraw the complete differential assembly.

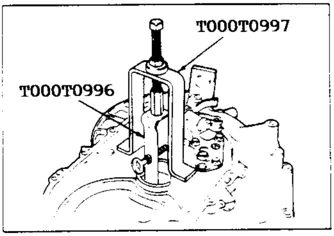
22. Interlock Pins: Remove the screws securing the interlock pin retaining plate/reverse fork pivot plate, and remove the plate. Remove the three interlock pins from their grooves in the clutch housing face.

23. Outer Races, Gearbox Case: Knock out or withdraw the input shaft and differential bearing outer races from the gearbox case. Do not misplace the shim washers from behind the bearing races.
To extract the differential bearing outer race, use special tool;

Outer Race Remover T000T0996
+ Puller Bridge T000T0997
(alternative slide hammer puller T000T0480)



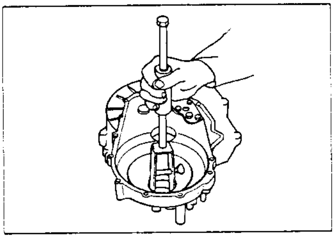
24. Output Shaft Seal: Press out the output shaft seal from the gearbox case.



25. Input/Output Shaft Bearing Outer Races, Clutch/Diff. Case: Use the following tools to extract the input and output shaft outer bearing races from the clutch/diff. case;

Outer Race Remover T000T0996
+ Puller Bridge T000T0997
(alternative slide hammer puller T000T0480)

Withdraw the oil nozzle from behind the output shaft race.



26. Diff. Bearing Outer Race, Clutch/Diff Case: Remove the outer race using the following puller and slide hammer;

Outer Race Remover T000T0996
Slide Hammer T000T0998

27. Oil Seals, Clutch/Diff. Case: Prise out the input shaft oil seal, and press out the output shaft seal.

28. Bearing Retainer Plate: If necessary, remove the 7 screws securing the bearing retainer plate, using a 'Torx' bit no. 45, and remove the plate. Discard the screws.

## FF.9 - MAJOR COMPONENT ASSEMBLY

### General

Before re-assembly:

Wash all parts thoroughly in clean solvent. Ensure all old lubricant, metallic particles, dirt or foreign material are removed from the surfaces of every part. Compressed air should be blown through each oil feed port and channel in each of the casing halves to remove any obstructions or cleaning solvent residue.

Inspect all gear teeth for signs of excessive wear or damage and check all gear splines for burrs, nicks, wear or damage. Remove minor nicks or scratches using an oil stone. Inspect all thrust washers for evidence of excessive wear, distortion or damage. Replace any part exhibiting excessive wear or damage.

Inspect the two case halves for cracks, porosity, damaged mating surfaces, stripped threads or distortion. Replace any part that exhibits these conditions.

Inspect the condition of all needle, roller, ball and thrust bearings. Wash bearings thoroughly in a cleaning solvent and blow dry. **Note:** Do not spin the bearings, or the rollers/balls may be damaged; turn slowly by hand; lubricate the bearings with a light oil and check for roughness by slowly turning by hand.

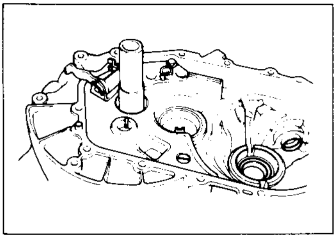
### Shimming

The input shaft, output shaft and differential assemblies are each supported by two taper roller bearings, with the endfloat/preload controlled by a shim washer fitted behind the bearing outer track in the gearbox casing. Each time the transmission is re-assembled, the shimming should be checked, and if any components are replaced it is likely that re-shimming will be required.

In order to aid shim selection, a special tool set T000T1005 is available, and should always be used because the special gauges apply a spring loading to the shaft bearings, in order to ensure they are fully seated and correctly aligned when the shim measurements are taken. Note that when using the gauges, the outer races must be removed from the gearbox casing (not from the clutch/diff housing) and the output shaft oil seal must not be fitted in the gearbox casing. The procedure for using the gauges is detailed in the following assembly sequence.

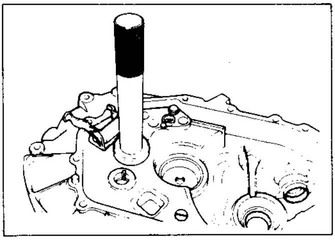
1. Input Shaft Oil Seal: Insert a new oil seal into the clutch housing, with the spring side of the seal towards the gearbox.

Oil Seal Installer T000T0999



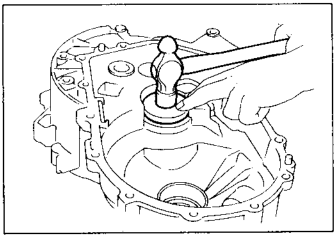
2. Outer Race, Input Shaft/Clutch Housing: Fit the input shaft outer race into the clutch housing using the installer with handle, and a hammer.

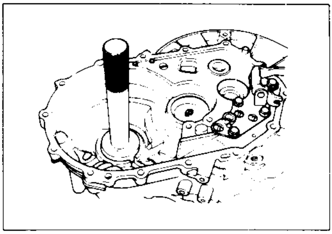
Installer T000T1000
Handle T000T1001



3. Outer Race, Output Shaft/Clutch Housing: Fit the oil nozzle into the bearing recess before fitting the output shaft outer race into the clutch housing using the installer and a hammer.

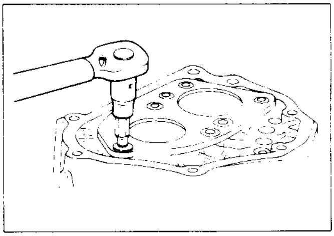
Installer T000T1002





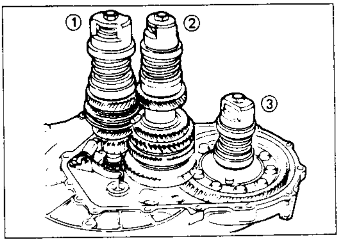
4. Outer Race, Differential/Diff. Housing: Fit the differential outer race into the differential housing using the installer with handle, and a hammer.

Installer T000T1003
Handle T000T1001



5. Bearing Retainer Plate: If removed, fit the bearing retainer plate to the gearbox casing using 7 new screws and a Torx bit no. 45.
Torque tighten to 19 Nm (14 lbf.ft).
For added security, stake the screws to the retainer plate.

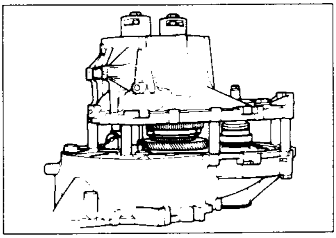
6. Shim Selection: i) Mount the clutch housing/differential case vertically, and install the three built up shaft assemblies; differential assembly, output shaft assembly less all 5th gear components (press off 5th driven gear sleeve and thrust washer if necessary), and input shaft assembly less 5th gear components.



ii) Place the bearing outer race onto each of the three shaft bearings, and place a shim select gauge over each shaft end so that it sits on the outer bearing race.

Shim Selector Gauge Set T000T1005

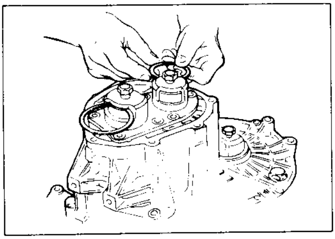
Note that the gauges are numbered;
1 - input shaft
2 - output shaft
3 - differential assembly
Check that all the gauges sit on the bearing outer race, and are not prevented from doing so by contact between the gauge compressor bolt and the shaft end.



iii) Place the seven spacers included in the shim selector set on every other mounting bolt hole. Place the gearbox housing (without outer races or output shaft oil seal fitted) over the shafts, and fit and tighten the bolts included in the set to the specified torque;
Torque = 18 Nm (13 lbf.ft)

Tightening the 7 bolts will compress the gauges and apply a spring loading to all the shaft bearings.
After tightening the 7 case bolts, check that each of the 3 gauge bolts is loose.

iv) Turn the input shaft and each gear in both directions several times to seat the bearings and gauges.



v) Measure the gap between the machined faces of each shim selector gauge using available shim sizes, and select the required shim for each of the 3 shafts in accordance with the following instructions and shim chart.

- the **input shaft** shim should be one size smaller than the largest shim that will fit in the gap.

- the **output shaft** should use the largest shim that can be placed into the gap and drawn through without binding.

- the **differential** should use a shim three sizes larger than that which will smoothly fit in the gap.

**Shim Selection Chart**

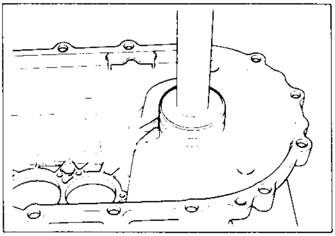
| Thickness mm (in) | Available | | | Thickness mm (in) | Available | | |
|---|---|---|---|---|---|---|---|
| | Input | Output | Diff | | Input | Output | Diff |
| 1.00 (0.039) | * | | | 1.76 (0.069) | * | | * |
| 1.04 (0.041) | * | | | 1.80 (0.071) | * | * | * |
| 1.08 (0.043) | * | | * | 1.84 (0.072) | * | | * |
| 1.12 (0.044) | * | | * | 1.88 (0.074) | * | * | * |
| 1.16 (0.046) | * | * | * | 1.92 (0.076) | * | | * |
| 1.20 (0.047) | * | | * | 1.96 (0.077) | * | * | * |
| 1.24 (0.049) | * | * | * | 2.00 (0.079) | * | | * |
| 1.28 (0.050) | * | | * | 2.04 (0.080) | * | * | |
| 1.32 (0.052) | * | * | * | 2.08 (0.082) | * | | |
| 1.36 (0.054) | * | | * | 2.12 (0.083) | * | * | |
| 1.40 (0.055) | * | * | * | 2.16 (0.085) | * | | |
| 1.44 (0.057) | * | | * | 2.20 (0.087) | * | * | |
| 1.48 (0.058) | * | * | * | 2.24 (0.088) | * | | |
| 1.52 (0.060) | * | | * | 2.28 (0.090) | * | * | |
| 1.56 (0.061) | * | * | * | 2.32 (0.091) | * | | |
| 1.60 (0.063) | * | | * | 2.36 (0.093) | * | * | |
| 1.64 (0.065) | * | * | * | 2.40 (0.094) | * | | |
| 1.68 (0.066) | * | | * | 2.44 (0.096) | * | * | |
| 1.72 (0.068) | * | * | * | 2.48 (0.098) | * | | |

Note that the 3 shims are different diameters, with the input shaft the largest, the differential middle size, and the output shaft the smallest.

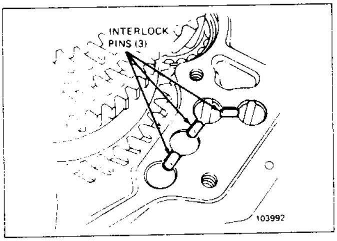
vi) When each of the three shims has been selected, remove the gearbox case, seven spacers and shim select gauges.

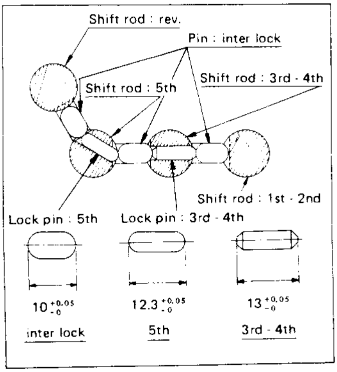
7. Outer Race, Differential, Gearbox Hsg.: Place the selected shim into the housing, and fit the differential outer race using the installer with handle, and a hammer.

Installer T000T1012; Handle T000T1001



8. Interlock Pins: Apply grease to the interlock pins and place into the housing grooves in the positions shown. Fit the retaining plate with reverse selector lever, but do not yet tighten the fixing screws.





9. Oil Deflector: Check that the oil deflector is fitted to the clutch/diff housing, and is secured with its two screws.

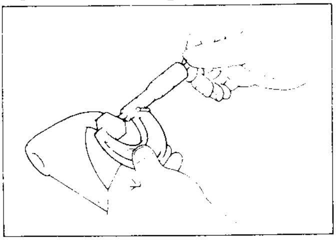
10. Differential Assembly: Place the differential assembly into position in the clutch/diff. housing.

11. Output Shaft Assembly: Place the outer race onto the output shaft LH bearing before fitting the 5th driven gear thrust washer (narrow end first) and needle bearing sleeve using a press.

12. Input & Output Shaft Installation: Fit the input and output shaft assemblies into position in the clutch/diff. housing, with all gears correctly meshing.

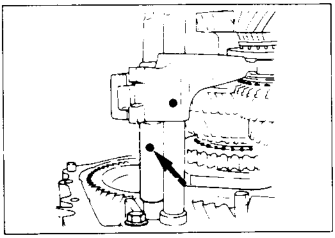
13. Selector Fork Check: Check the thickness of all selector fork pads, and replace if below specification;

| | |
|---|---|
| Except reverse | 7.5 mm minimum |
| Reverse | 7.4 mm minimum |

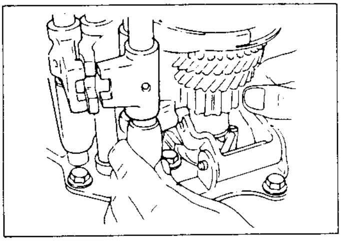


14. Selector Shaft & Fork, 3rd/4th: Check that the interlock pin (for identification see above) is fitted into the shaft end. Position the 3rd/4th speed fork (steel) into its synchroniser groove on the input shaft, and slide the shaft through the fork and into the housing. Note that the correct hole in the interlock plunger retaining plate may be identified by the raised collar. Secure the fork to the shaft using a new roll pin (short).

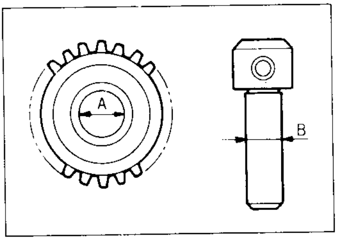
15. Interlock Plate Fixings: Tighten the interlock plate fixing screws to 19 Nm (14 lbf.ft).



16. Selector Shaft & Fork, 1st/2nd: Position the 1st/2nd selector fork into its synchroniser groove on the output shaft, and insert the selector shaft through the fork and into the clutch/ diff. housing bore with the interlock groove aligned. Fix the fork to the shaft using a new roll pin (long).



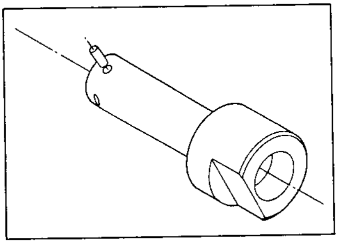
17. Selector Shaft & Block, 5th & Rev.: With the 5th and reverse shafts assembled with the operating block and reverse relay spigot (leave off the 5th shaft circlip), check that the interlock plunger (for identification see above) is fitted into the end of the 5th speed shaft. Position the two shafts and let the reverse shaft drop to the neutral position whilst engaging the reverse relay spigot with the reverse lever. Insert the 5th speed shaft through the interlock plate. Fit the circlip to the 5th speed shaft, below the operating block.



18. Reverse Idler Gear & Shaft: i) Measure the inside diameter of the gear (A), and the outside diameter of the shaft (B) to determine the running clearance;

A - B 0.15 mm maximum

Replace both components if outside specification.



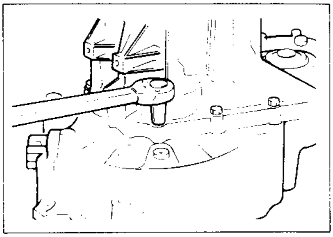
ii) Fit the reverse idler gear onto its shaft (gearteeth end first), and fit the location pin into the shaft as shown in the diagram. Fit the shaft into the housing with the location pin in the slot pointing towards the output shaft.

19. Gutter & Magnet: Check that the oil gutter is secured to the gearbox casing with its single screw, and that the magnet is fitted into its slot in the clutch/diff housing.

20. Input & Output Shaft Shims: Place the outer race onto the input shaft LH bearing. Place the input and output shaft shims as previously determined onto the outer races of the input and output shaft bearings.

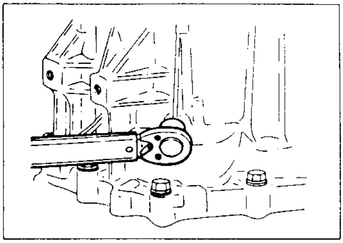
21. Gearbox Casing: Clean any oil and other matter from the joint faces of the gearbox case and clutch/diff. housing and apply a 3mm bead of liquid gasket 'Loctite 518' to the clutch/diff. housing.
Check that the two dowels are fitted in the clutch/diff. housing before carefully fitting the gearbox casing over the shafts, and inserting the retaining bolts.

Torque to 37 Nm (27 lbf.ft).



22. Bolt & Washer, Idler Shaft: Fit the reverse idler gear shaft retaining bolt and copper washer. Correct thread engagement is more easily achieved if the casing is positioned with the hole beneath, so that the shaft lies against the case.

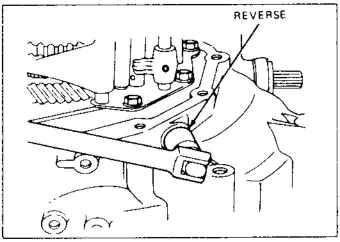
Torque to 37 Nm (27 lbf.ft)



23. Reverse Detent: Check the free length of the reverse detent spring, and replace if below specification;

Length = 59.5 mm minimum

Fit the detent ball, spring and plug.
Torque tighten to 25 Nm (19 lbf.ft).

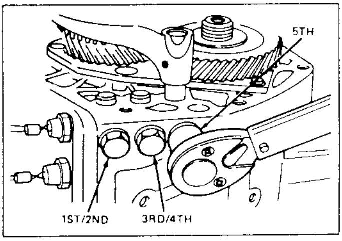


24. Shift Detent, Forward Speeds: Check the free length of the detent springs, and replace if below specification.

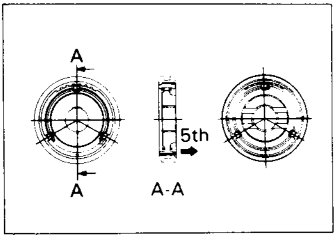
Free length = 25.5 mm minimum

Fit the balls and springs, and secure with the retaining plugs.

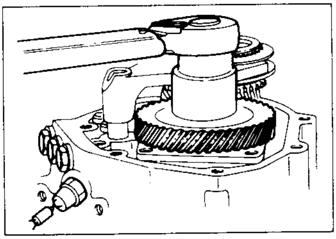
Torque to 25 Nm (19 lbf.ft)



25. 5th Gear Pair: Fit 5th drive gear onto the input shaft. Lubricate the driven gear needle roller bearing with gearbox oil and fit onto the output shaft sleeve. Fit 5th driven gear over the bearing.



26. 5th Synchroniser Assembly: Fit the synchro ring onto the driven gear. Position the synchroniser assembly (the correct way round), with the 5th selector fork positioned in its groove, and fit the two components together onto the output shaft and selector shaft respectively.
Ensure that the synchro ring dogs engage with the synchroniser slots.

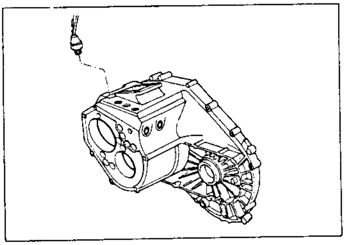


27. 5th Gear Pair Nuts: Fit the synchro stopper plate over the output shaft. Clean the threads on both shafts and apply a thread locking compound (Loctite 262 or equivalent). Fit new nuts to both shafts. Lock the shafts by engaging 3rd or 4th gear, and then engaging 5th gear by sliding the selector fork on its shaft. Torque tighten both nuts.

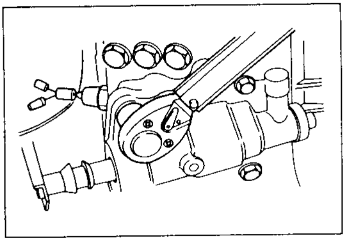
Torque to 127 Nm (94 lbf.ft)

Stake both the nuts securely in two places. Select neutral.

28. 5th Selector Fork: Secure 5th selector fork to its shaft using a new roll pin.



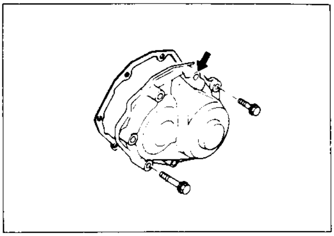
29. Reverse Switch: Install and tighten the reverse light switch with its aluminium washer.



30. Selector Housing Assembly: Fit the selector housing assembly using a new gasket, and fit and tighten the fixing screws.

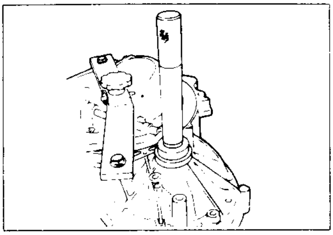
Torque to 19 Nm (14 lbf.ft)

Check that all gears can be selected.



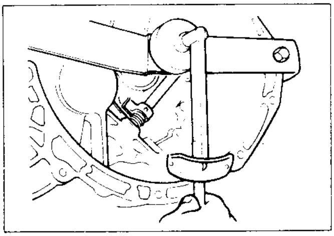
31. End Cover: Check that the input shaft oil nozzle is fitted into the end cover. Fit the cover using a new gasket, and insert the retaining bolts. Apply a liquid gasket to the threaded portion of the screw in the position shown.

Torque to 19 Nm (14 lbf.ft)



32. Output Shaft Oil Seals: New oil seals should be used at each re-assembly. Fit the seals using the installer with handle, and a hammer.

Installer T000T1004
Handle T000T1001



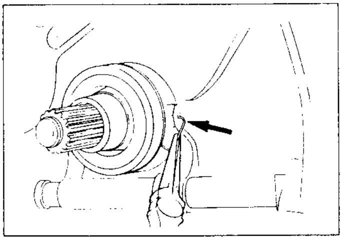
33. Input Shaft Rotating Torque: Position the transmission with the input shaft uppermost and differential lowermost. With the transmission in neutral, use a low range torque wrench to measure the torque required to rotate the input shaft at steady speed. (i.e. NOT starting torque)

Rotating Torque = 8 kg.cm (7 lbf.in) max.

If the torque exceeds this figure, the transmission should be disassembled and the shims re-selected.

34. Clutch Release Fork & Shaft: Apply high temperature grease to the bearing surfaces of the shaft and fork. Insert the shaft into the housing from the inside, locate the spring over the shaft end, and fit the shaft into the end bush. Use the special tools to fit the outer bush into position, followed by the seal. Fit the dust cap and operating arm.

Clutch Shaft Bush Inserter/Remover T000T0992

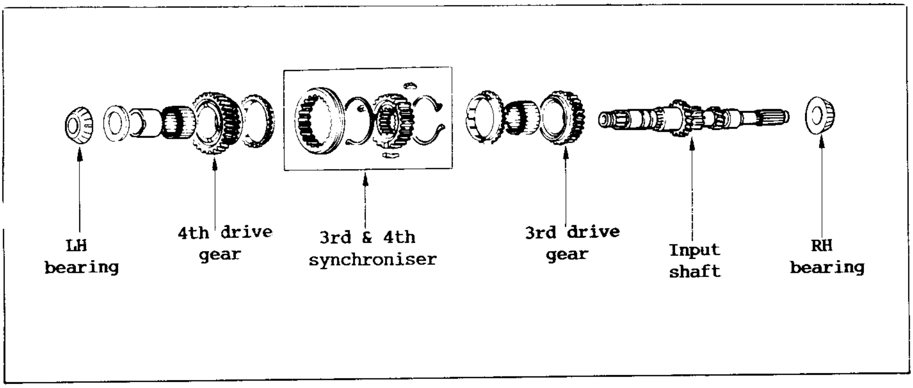


35. Release Bearing: Apply high temperature grease to the sliding surfaces of the bearing and release fork. Fit the retainer spring around the release bearing groove, with the ends of the spring angled towards the gearbox casing. Fit the release bearing over the guide tube with the spring 'wrap' away from the fork shaft and the flats of the bearing against each fork leg. Hook the ends of the spring into the fork leg holes.

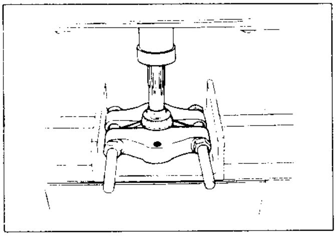
## FF.10 - INPUT AND OUTPUT SHAFT DISASSEMBLY/ASSEMBLY

### Input Shaft Disassembly

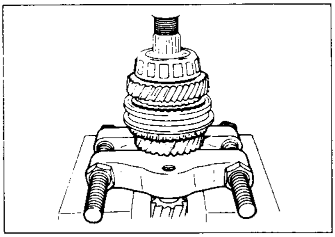
The input shaft assembly consists of the input shaft with its integral first, second and reverse gear drive pinions, right and left hand taper roller bearings (less outer races), third and fourth gear free drive pinions, and the third/fourth speed synchroniser assembly.



1. Input Shaft R.H. Bearing: Remove the right hand bearing using a suitable bearing remover and a press.

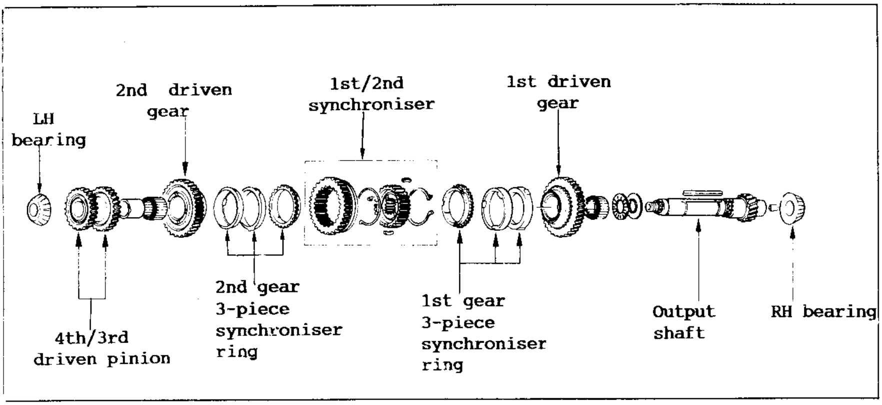


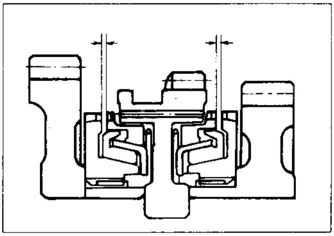
2. Input Shaft L.H. Bearing, 3rd & 4th Drive Gears & 3rd/4th Synchroniser Assembly: Fit the bearing remover behind 3rd speed drive gear and use a press to remove the complete bearing/gear/synchro assembly.



### Output Shaft Disassembly

The output shaft assembly consists of the output shaft with integral final drive pinion, right and left hand taper roller bearings (less outer races), third/fourth speed driven gear pair, first and second speed free pinions, and the first/second speed synchroniser assembly.

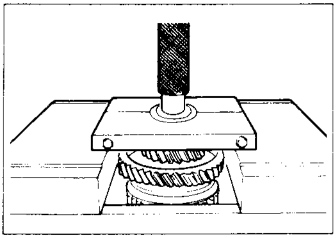

LH bearing
2nd driven gear
1st/2nd synchroniser
1st driven gear
4th/3rd driven pinion
2nd gear 3-piece synchroniser ring
1st gear 3-piece synchroniser ring
Output shaft
RH bearing



1. 1st/2nd Synchro Check: Wear of the 1st and 2nd synchro rings may be assessed prior to dissassembly of the output shaft. Move the synchroniser sleeve to press one of the synchro rings against its gear, and measure the clearance between the synchro ring and the dog tooth flange on the gear.

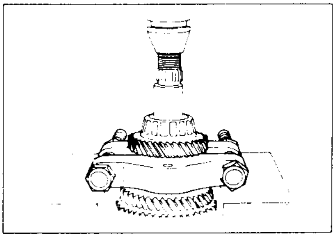
Clearance = 0.8 mm minimum

If the dimension is below specification, the 3 part synchro ring assembly should be replaced.



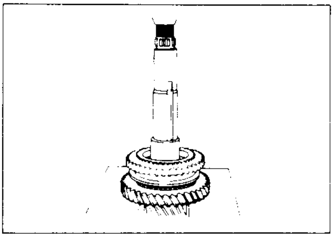
2. Output Shaft R.H. Bearing: Remove the right hand bearing using the bearing remover and a suitable short bar with a press.

Bearing remover T000T1007



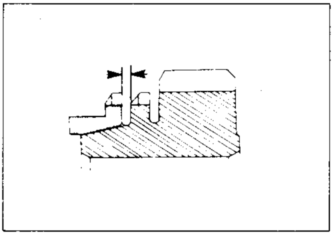
3. Output Shaft L.H. Bearing & 3rd/4th Gear: Remove the left hand bearing together with the 3rd/4th driven gear pair, 5th driven gear thrust washer and needle bearing sleeve. Use a bearing remover located behind the 4th gear wheel, and a press. Also remove the 3rd/4th gear key from the shaft keyway.

4. 2nd Gear, Needle Bearing & Synchro Ring: Slide off the 2nd speed driven gear with its needle roller bearing. Remove the 2nd speed 3-piece synchro ring set.



5. 1st/2nd Synchroniser, 1st Gear & Bearing: Use a press to remove the 1st speed driven gear, 1st/2nd synchroniser assembly, and 2nd gear needle roller sleeve, in one operation.
Also remove the 1st gear needle roller bearing, needle roller thrust bearing and thrust washer.

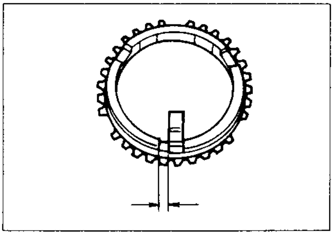
Inspection of Components



1. Synchro Rings: i) Fit the 3rd, 4th and 5th speed synchro rings, and the 1st and 2nd speed 3-piece synchro ring assemblies onto their corresponding gears, and measure the clearance between the ring and the dog tooth flange.

Clearance = 0.8 mm minimum

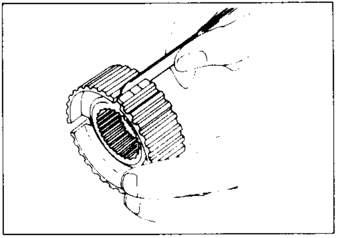
Replace the syncro ring if below specification.



ii) Measure the clearance between each synchro ring slot and a hub insert.

Clearance - 1st/2nd = 3.9 mm max.
- 3rd/4th, 5th = 3.7 mm max.

Replace the synchro ring if the dimension exceeds the specification.

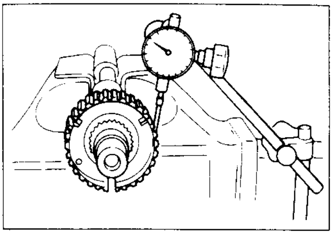


2. Synchro Hub: i) Measure the clearance between the synchro hub slots and inserts.

Clearance = 0.25 mm maximum.

If the clearance exceeds specification, replace the synchroniser assembly.

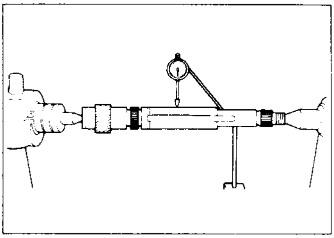
ii) Hub Splines: Fit each synchro hub onto its shaft splines, and measure the spline free play using a dial gauge as shown.



Free play - 1st/2nd, 3rd/4th = 0.12 mm max.
- 5th = 0.15 mm max.

If the clearance exceeds specification, replace the hub and/or shaft as necessary.

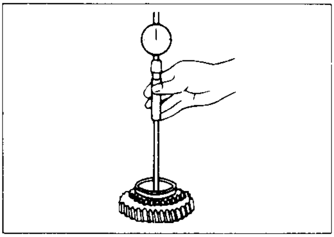
3. Shaft Run-Out: Measure the run-out of the input and output shafts.



Run-out = 0.02 mm maximum

Replace the shaft if the run-out exceeds specification.

4. Gear Inside Diameter: Measure the inside diameter of each of the free gear pinions.

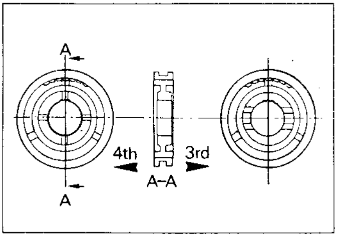


Diameter - 1st, 2nd = 45.05 mm max.
- 3rd, 4th, 5th = 41.05 mm max.

Replace the gear if the dimension exceeds specification.

Input Shaft Re-assembly

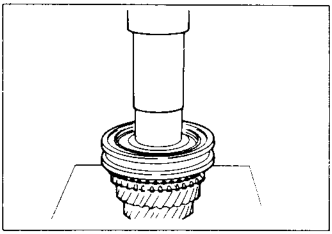
1. 3rd Gear & Needle Bearing: Lubricate the 3rd gear needle bearing with transmission oil, and fit onto the input shaft. Fit 3rd speed drive gear over the bearing.



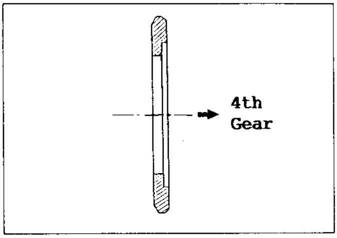
2. 3rd/4th Synchroniser Assembly: Assemble the 3rd/4th synchroniser assembly, with the ends of the two springs positioned 180° apart on opposite sides of the hub. The ends of the springs should not interfere with the sliding action of the hub.
Fit 3rd speed synchro ring onto the 3rd speed drive gear.
Fit the synchroniser onto the input shaft, 3rd gear side first (greater hub length + identification groove in sleeve) and press into position, ensuring that the synchro ring dogs are aligned with the slots in the synchro hub.
Installer T000T1008

3. 4th Gear Sleeve: Fit the 4th gear needle bearing sleeve onto the shaft and use the bearing installer with a press to fit into position.

Installer T000T1008

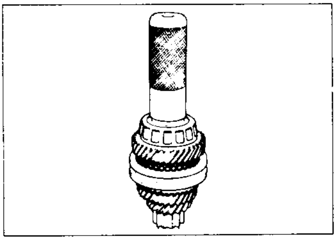


4. 4th Gear, Bearing & Thrust Washer: Lubricate the 4th gear needle roller bearing with transmission oil, and fit onto the shaft.
Fit the 4th speed synchro ring into the synchroniser.
Fit 4th drive gear over its needle bearing on the shaft.
Lubricate the 4th gear thrust washer, and fit onto the shaft with the stepped side towards 4th gear.



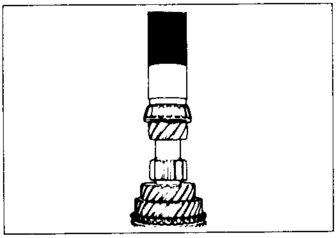
5. Left Hand Bearing: Fit the left hand taper roller bearing onto the shaft using the installer and a press.

Installer T000T1008



6. Right Hand Bearing: Fit the right hand taper roller bearing onto the shaft using the installer and a press.

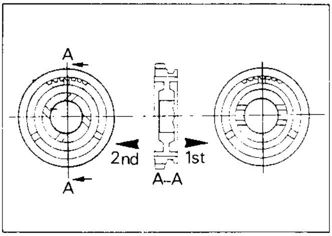
Installer T000T1008



Output Shaft Re-assembly

1. 1st Gear & Bearings: Fit the 1st gear thrust washer onto the output shaft. Lubricate the needle roller thrust bearing with transmission oil, and fit onto the shaft. Lubricate the 1st gear needle bearing, and fit onto the shaft followed by the 1st speed gear.

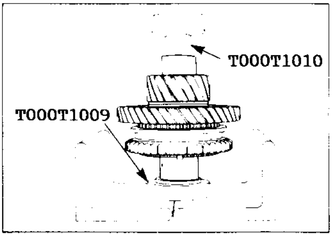
2. 1st/2nd Synchroniser Assembly:
Assemble the 1st/2nd synchroniser assembly, with the ends of the two springs positioned 180° apart on opposite sides of the hub. The ends of the springs should not interfere with the hub sliding action of the sleeve.
Fit the 3-piece 1st gear synchro ring assembly onto the 1st speed drive gear.
Fit the synchroniser onto the output shaft 1st gear side first - refer to diagram.



3. 2nd Gear Sleeve: Fit the 2nd gear sleeve onto the shaft, and use the installer collars and a press to fit the sleeve and synchroniser up to the shoulder on the shaft.

Installer collar (I) T000T1009
Installer collar (II) T000T1010)

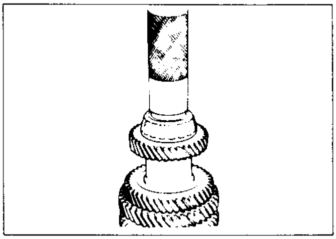
**Note** Ensure that the 1st gear synchro ring dogs align with the synchro hub slots as the hub is pressed into position.



4. 2nd Gear, Needle Bearing & Synchro Ring: Lubricate 2nd gear needle roller bearing with transmission oil, and fit onto the sleeve. Assemble the 3-piece 2nd speed synchro ring, and fit into the synchroniser assembly. Fit 2nd speed gear over the needle bearing.

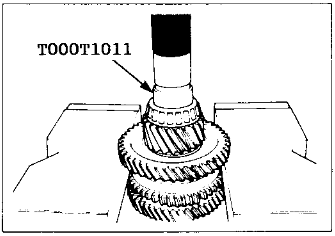
5. 3rd/4th Gear Pair & L.H. Bearing: Fit the rectangular section key into its keyway in the shaft.
Fit the 3rd/4th Gear pair onto the shaft, larger (3rd gear) end first, and press the gear together with the L.H. bearing into position using the installer and a press.

Installer T000T1008

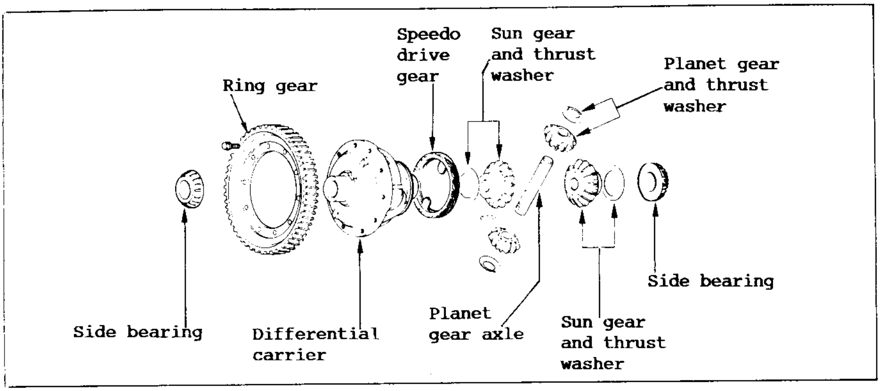


6. R.H. Bearing: Fit the R.H. bearing onto the shaft using the installer and a press.

Installer T000T1011



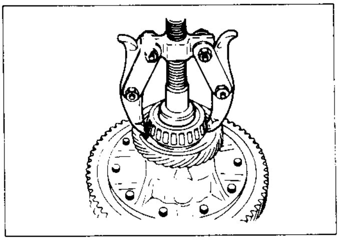
## FF.11 - FINAL DRIVE DISASSEMBLY/ASSEMBLY


Speedo drive gear
Sun gear and thrust washer
Planet gear and thrust washer
Ring gear
Side bearing
Side bearing
Differential carrier
Planet gear axle
Sun gear and thrust washer

With the final drive assembly removed from the transmission (see section FF.8), proceed as follows:

Disassembly

1. Side Bearings: Use a suitable puller tool to draw both side bearings from the differential carrier, and label the bearings with their side.



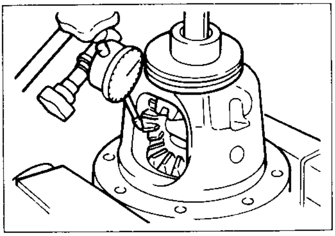
2. Speedometer Drive Gear: The speedo drive gear should not be re-fitted once removed. A new gear should be used. Use a suitable puller or other method to remove the gear, and discard.

3. Ring Gear: Remove the ring of bolts securing the ring gear to the diff. carrier, and remove the gear.

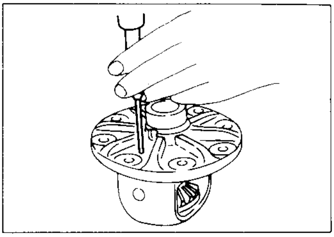
4. Differential Gears: i) To check the gears and thrust washers for wear, hold a sun gear (output) stationary and use a dial gauge to measure the backlash at a planet gear as shown.

Limit = 0.3 mm maximum.

If the backlash exceeds this figure, replace all the diff. gear thrust washers.



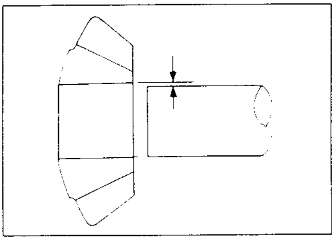
ii) Break the staking on the planet gear axle locking pin using a 5mm drill. Drive out the locking pin using a pin punch, and slide out the planet gear axle. Remove the differential gears, taking care to note the fitted positions of the gears and thrust washers.



5. Planet Gears & Axle: Measure the internal diameter of the planet gears, and external diameter of the axle to establish the clearance between the two components.

Limit = 0.2 mm maximum.

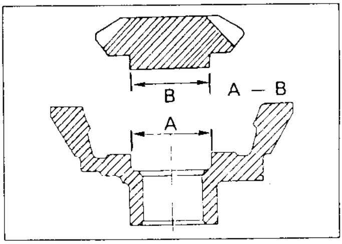
Replace the gears and axle if clearance exceeds this figure.



6. Sun Gears: Measure the ouside diameter of the sun gear bearing surface, and the corresponding inside diameter of the diff. carrier. Establish the running clearance.

Limit = 0.15 mm maximum

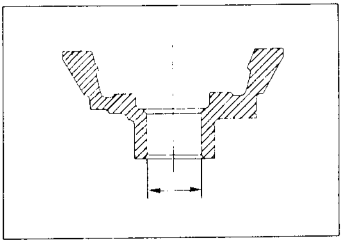
Replace the sun gear and differential carrier if clearance exceeds this figure.



7. Differential Carrier: Measure the diameter of the diff. carrier at each driveshaft spigot.

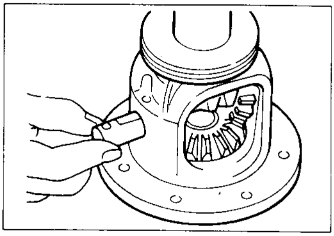
Limit = 27.35 mm maximum.

Replace the diff. carrier if the diameter exceeds this figure.



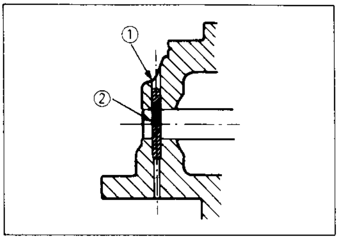
Assembly

1. Differential: Lubricate all components with transmission oil before assembly. Fit the sun gears and thrust washers into the carrier in their original positions. Fit the two planet gears and thrust washers into position, and insert the planet gear axle with the lock pin hole aligned. Check backlash between gears as in (4) above.



2. Lock Pin: Install the planet gear axle lock pin using a pin punch to drive the pin to the bottom of its bore. Stake the end of the lock pin hole with a punch to retain the pin.

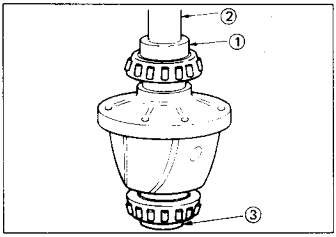
1: Stake here
2: Lock pin



3. Speedo Drive Gear: Fit only a new speedo drive gear. Heat the gear to approx. 90°C (194°F) using an oil heater or hot air blower (but do **NOT** use hot water), and install the gear on the carrier.

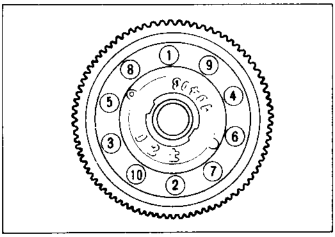
4. Side Bearings: Use the following tools to press both side bearings into position on the carrier.

| | | |
|---|---|---|
| Installer | T000T1012 | (1) |
| Handle | T000T1001 | (2) |
| Pilot | T000T1013 | (3) |

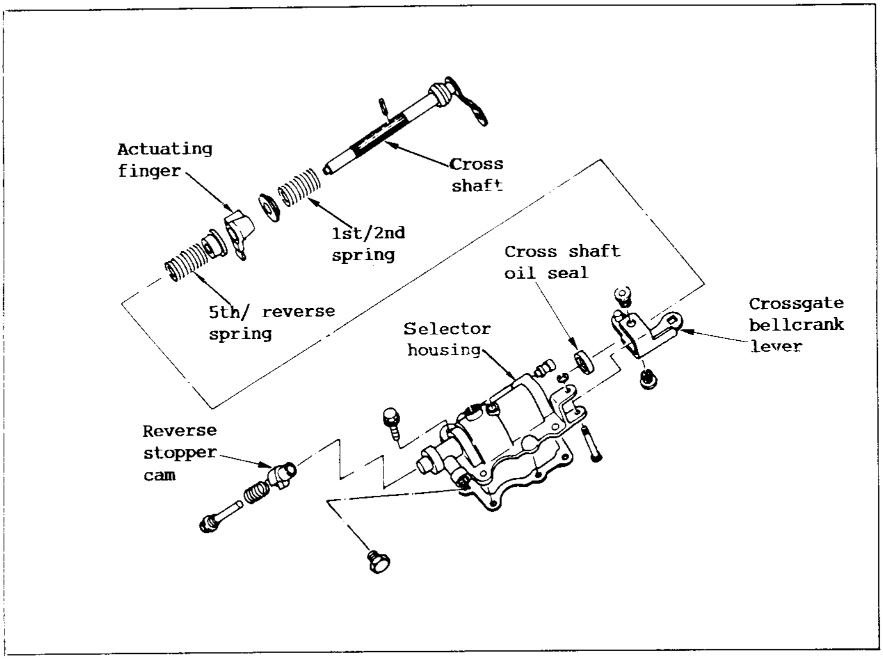


5. Ring Gear: Apply oil to the mating surfaces of the ring gear and diff. carrier and fit the ring gear in position. Secure the gear using **NEW** bolts (with pre-applied thread locking compound) with **un**-oiled threads.

Torque to 113 Nm (83 lbf.ft)



FF.12 - SELECTOR HOUSING DISASSEMBLY/ASSEMBLY


Actuating finger
Cross shaft
1st/2nd spring
Cross shaft oil seal
5th/ reverse spring
Selector housing
Crossgate bellcrank lever
Reverse stopper cam

1. Remove Housing: Disconnect the two gearchange cables, release the four screws securing the housing, and remove the complete assembly and gasket.

2. Crossgate Bellcrank: Remove the snap ring and pivot pin to release the crossgate bellcrank lever.

3. Cross Shaft Assembly: Use a pin punch to remove the spring pin securing the actuating finger to the cross shaft, and discard the pin. Withdraw the cross shaft, and remove the actuating finger, cross shaft springs and spring seats.

4. Reverse Inhibitor: Remove the reverse inhibitor bolt, stopper cam and spring.

5. Oil Seal: Prise out the cross shaft oil seal.

Assembly

6. Cross Shaft Springs: Measure the free length of the cross shaft springs and replace if shorter than the minimum length.
Free length - 1st/2nd = 42.9 mm minimum
- 5th/rev = 61.6 mm minimum

7. Oil Seal: Press a new cross shaft oil seal into the casing.

8. Reverse Inhibitor: Fit the stopper cam, spring, and bolt.

9. Cross Shaft Assembly: Assemble the cross shaft springs and seats, and actuating finger into the housing, noting that the longer (5th/rev.) spring is fitted at the reverse inhibitor end of the housing. Insert the cross shaft, taking care to align a setting mark on the 5th/rev. spring seat, with the centre line of the actuating finger. Use a new spring pin to secure the finger to the cross shaft.

After assembly, check that the reverse inhibitor mechanism functions correctly.

10. Crossgate Bellcrank: Fit the bellcrank lever into position, and fit the pivot pin and snap ring.

11. Fit Housing: Fit the housing assembly using a new gasket, and fit and tighten the fixing screws. Refit gearchange cables.

Torque housing fixings to 19 Nm (14 lbf.ft).

## FF.13 - DRIVESHAFTS

To enable similar length drive shafts to be used, and thus reduce the effects of torque steer, a jackshaft is used on the right hand side in order to extend the transmission output shaft to a position symmetrical with the left hand side. The jackshaft is supported at its outboard end by a ball bearing bolted to the rear of the engine.

Both driveshaft assemblies use plunging tripod type inboard C.V. joints, and six ball Birfield type outboard C.V. joints. The outboard joint is available as a service part, as is the inboard joint complete with shaft. Replacement gaiter kits are available for both joints. The joints themselves are packed with grease on initial assembly, and are maintenance free. It is however vitally important that the protective gaiters are carefully inspected at service intervals, to check for splits, tears or punctures, since the joint will deteriorate very quickly once contaminated with dirt or water. Damaged gaiters should be renewed immediately, once the servicibility of the joint has been established.

Outer joints tend to wear more quickly than inboard joints due to their greater angularity in operation, but if an outboard joint is found to be worn out due to high mileage, rather than contamination via a damaged boot, it is recommmended to fit a complete replacement driveshaft assembly. A clicking noise when turning, is a typical symptom of a worn outboard joint. A 'clunk' produced by engine torque reversals, or a shudder or vibration when accelerating, can indicate a worn inboard joint. Any symptoms that could be due to worn driveshaft joint assemblies, should be investigated and rectified without delay, since safety considerations are always paramount.

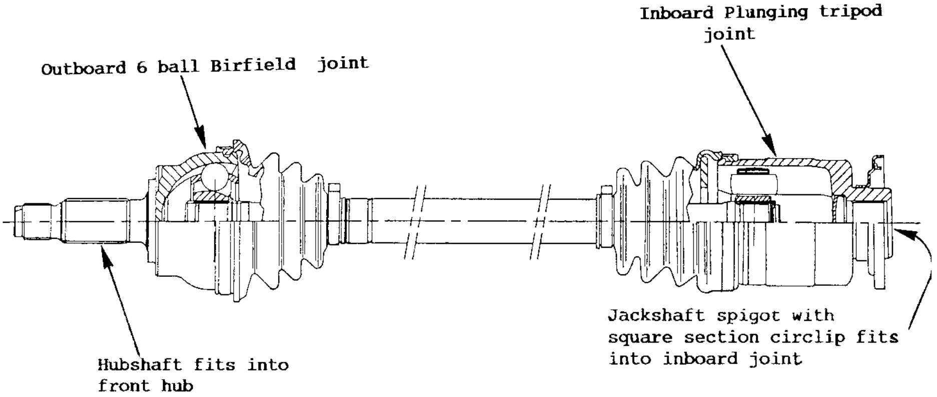
### Driveshaft Removal

1. Hub Nut: Release the driveshaft hub nut.

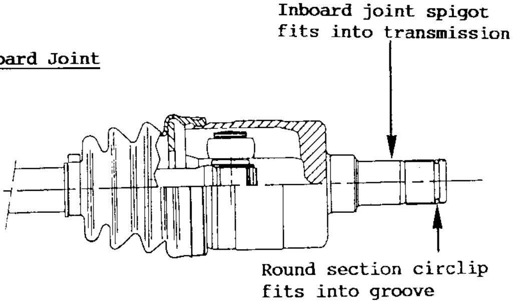
2. Brake Hose: Remove the clip securing the brake hose to the top wishbone, and release the brake hose from the bracket.

3. Top Ball Joint: Mark the position of the camber adjustment eccentrics on the top ball joint to wishbone fixing bolt, and remove the two ball joint bolts. Note and record the positioning of the castor adjustment shim plates.

**RH Driveshaft Assembly**


Inboard Plunging tripod joint
Outboard 6 ball Birfield joint
Jackshaft spigot with square section circlip fits into inboard joint
Hubshaft fits into front hub

**LH Inboard Joint**


Inboard joint spigot fits into transmission
Round section circlip fits into groove

4. Inboard C.V. Joint: The inboard joint is retained on the transmission output shaft by a rounded section circlip, and is removed by applying a shock pull to the C.V. joint body. Use a slide hammer with a forked end, or apply a sharp blow to a carefully placed lever.

> CAUTION: Do NOT attempt to remove the inboard C.V. joint from the transmission by pulling on the driveshaft. This action will cause the joint to become disassembled and may entail replacement of the joint. The components of the inboard plunging joint are held in position, for transit purposes only, by a collar within the boot which will be overidden if excessive axial force is used. Apply pressure only to the 'tulip' or outer shell of the joint.

5. Blanking Plug: Withdraw the inboard C.V. joint from the transmission output shaft, and fit blanking plug T000T1014 into the transmission to limit the amount of transmission oil loss.

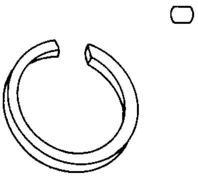
6. Damper Yoke: Remove the nuts from the bolts securing the yoke to the damper body, and the nut from the bolt securing the yoke to the lower link. Leave the bolts in place to support the weight of the hub assembly, and withdraw the rear half of the yoke

7. Press the outboard stub shaft from the hub bearing.

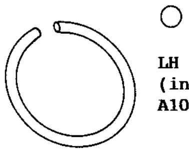
Driveshaft Replacement

Note that the LH driveshaft assembly has a male spigot on the inboard joint, and the RH assembly a female spigot.

Each inboard joint is retained to its transmission output shaft by a circlip, which should be replaced EACH TIME a driveshaft is removed. Note that the circlip fitted on the male spigot of the LH inboard C.V. joint is of round section, whereas the circlip retaining the RH inboard C.V. joint (and fitted on the end of the transmission output extension shaft), is square in section. The two circlips are therefore NOT interchangeable, and care should be taken to ensure that no mix up occurs.



**RH side**
**(extension shaft)**
**A100F6095H**



**LH side**
**(inboard C.V. joint)**
**A100R6001F**

1. Inboard Joints: Fit a new circlip onto the inboard C.V. joint spigot shaft (LH) or transmission output extension shaft (RH). Press the inboard joint fully into (onto) the output shaft until the retaining circlip is located in its groove. Check by pulling on the joint.

2. Re-assembly: Feed the outboard joint stub shaft through the hub bearing, and rebuild the suspension in reverse order to dis-assembly, taking care to refit washers, castor adjustment shim plates, and camber adjustment eccentrics in their original positions.

Torque settings:
- damper yoke to lower link; 75 - 80 Nm (55 - 59 lbf.ft)
- damper yoke to strut; 35 - 38 Nm (26 - 28 lbf.ft)
- top ball joint to top link; 22 - 25 Nm (16 - 18 lbf.ft)
- hub nut; 225 - 235 Nm (166 - 173 lbf.ft) & deform nut into recess in shaft end

C.V. Joint and Gaiter Replacement

1. Driveshaft Assembly: Remove the driveshaft assembly from the car (see above).

2. Gaiters: Cut off the gaiters and clips from both driveshaft joints.

3. Remove Outboard Joint: The outboard joint is retained by a round section circlip on the end of the shaft. To remove the joint, hold the drive shaft in a vice, and use a soft mallet to tap the joint over the circlip and off the shaft.

If the joint is reluctant to move, use a brass drift on the front face of the inner race.

CAUTION: Do not attempt to remove an outboard joint without first removing the shaft assembly from the car. Unless the shaft is securely retained (e.g. in vise) attempts to remove the outboard joint may result in the inboard joint becoming disassembled.

4. Cleaning and Inspection: Complete disassembly of either joint is NOT recommended. The separate components are a precision fit and develop their own individual wear patterns, such that any interchanging of parts is likely to result in premature failure.

If the grease in the joint is contaminated with dirt or water, it is likely that the joint is damaged, and should be replaced. If the grease is not contaminated, the joint should be degreased by soaking in a suitable solvent (NOT petrol), and then carefully inspected.

On the outboard ball type joint, tilt the inner race to one side to expose each ball. Severe pitting, galling, play between ball and its cage window, any cracking or damage to the cage, or pitting, galling or chips in raceways, call for joint replacement.

On the inboard, tripod type joint, examine the fit between the rollers and the housing. Excessive free play, roughness on either roller or track surfaces, damage to the bearings or trunnion, call for joint replacement. If the joint is found to be serviceable, it must be repacked with special grease as follows:

| | | | |
|---|---|---|---|
| Outboard joint; | 1 sachet A100R6009 | (52 ml) | - boot kit contains 2 sachets |
| Inboard joint; | 2 sachet A100R6010 | (62 ml) | - boot kit contains 3 sachets |

5. Replace Circlips: Replace the circlips securing the inboard joint to the diff. output shaft (or extension shaft), and the outboard joint to the shaft. New circlips should always be used to ensure security of joint retention. Note that the circlip for the outboard joint is supplied in the boot kit for either joint, but that the inboard joint circlip should be ordered separately.

6. Fit Boots: Tape over the shaft outboard splines to prevent damage to the new boots, and slide the inboard boot and small retaining clip onto the shaft, followed by the outboard boot small clip and boot. Remove the tape.

7. Outboard Joint: New joints are pre-packed with grease, but if re-fitting a cleaned out joint, lubricate the joint with **one** sachet of the special grease provided in the boot kit. Fill the ball tracks with grease both behind and in front of the balls, pack around the balls, and the inside of the splines, so that grease is pushed behind the joint when the shaft is inserted. Use the second grease sachet from the boot kit to fill the inside of the new boot.

**NOTE:** The grease provided in the kits is specially formulated for wear resistance and durability. DO NOT use substitutes or mix with other lubricants.

8. Outer Joints: If re-fitting a cleaned out joint, pack the joint with **two** of the grease sachets from the boot kit. Slide the outer joint onto the shaft splines, and tap the joint into position until the circlip 'clicks' into its groove. Pull on the joint to ensure it is fully located. Use the third grease sachet from the boot kit to fill the inside of the new boot.

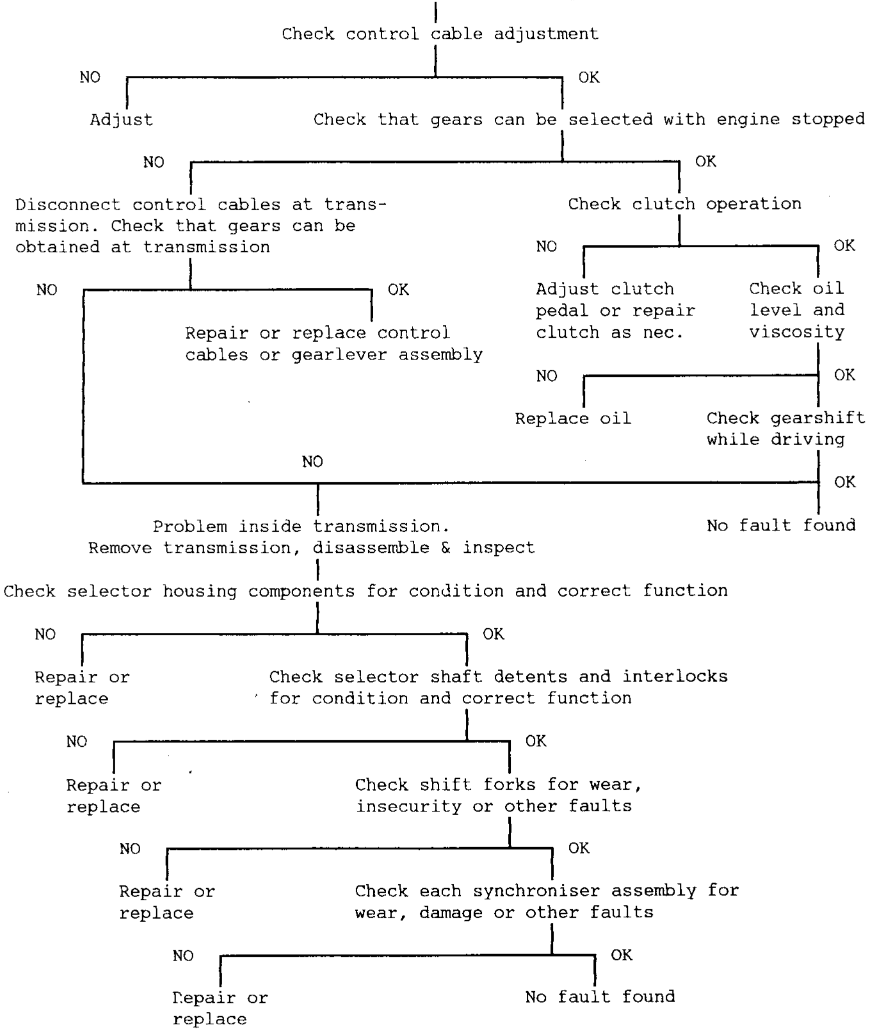
9. Retain Boots: Pull each boot over its C.V. joint and locate the lips of the boot in the grooves on the joint and shaft. Before fitting the boot clamps, ensure that the boot is ventilated so that it is not dimpled or collapsed. Position the plurging joint with 80 mm between the boot clip grooves before ventilating by inserting a smooth rod (take care not to damage the boot) between

the large end of the boot and the joint, and fitting the retaining clips. Tighten the clips using suitable pliers.

10. Refit the driveshaft assemblies to the car (see above).

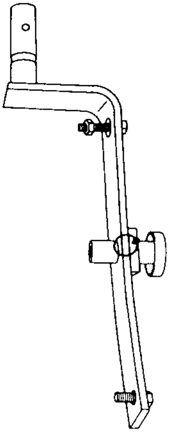
## FF.14 - FAULT DIAGNOSIS

**Stiff or Difficult Gearchange**

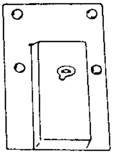

Check control cable adjustment
NO
OK
Adjust
Check that gears can be selected with engine stopped
NO
OK
Disconnect control cables at transmission. Check that gears can be obtained at transmission
Check clutch operation
NO
OK
NO
OK
Repair or replace control cables or gearlever assembly
Adjust clutch pedal or repair clutch as nec.
Check oil level and viscosity
NO
OK
Replace oil
Check gearshift while driving
NO
OK
Problem inside transmission. Remove transmission, disassemble & inspect
No fault found
Check selector housing components for condition and correct function
NO
OK
Repair or replace
Check selector shaft detents and interlocks for condition and correct function
NO
OK
Repair or replace
Check shift forks for wear, insecurity or other faults
NO
OK
Repair or replace
Check each synchroniser assembly for wear, damage or other faults
NO
OK
Repair or replace
No fault found

## FF.15 - SPECIAL TOOLS

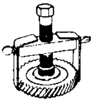
Transmission Assembly Holding Fixture T000T0993



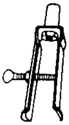
Fixing Base T000T0994



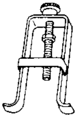
Puller, 5th Drive Gear T000T0995



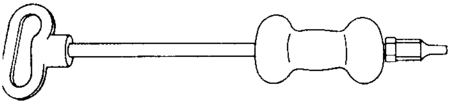
Puller, Diff Bearing Race T000T0996



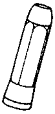
Puller Bridge T000T0997



Slide Hammer T000T0998

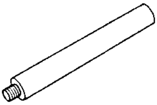


Input Shaft Oil Seal Installer T000T0999

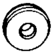


Input Shaft Bearing Race Installer T000T1000

Handle, Bearing Installer T000T1001

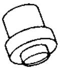


Output Shaft RH Race Installer T000T1002

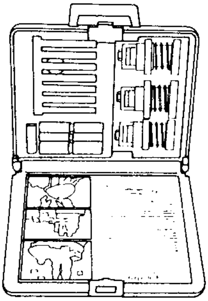


Diff. Bearing Outer Race Installer T000T1003

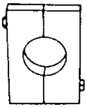
Output Shaft Oil Seal Installer T000T1004



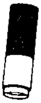
Shim Selector Gauge Set T000T1005



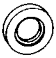
Output Shaft RH Bearing Remover T000T1007



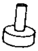
3rd/4th Synchro Installer T000T1008



2nd Gear Sleeve Installer Collars T000T1009 & T000T1010



Output Shaft RH Bearing Installer T000T1011



Diff. Bearing Installer T000T1012

Diff. Bearing Pilot T000T1013

Output Shaft Aperture Blanking Plug T000T1014

Clutch Release Fork Shaft Bush Replacer T000T0992

# WHEELS & TYRES

## SECTION GD - ELAN

| | Sub-Section | Page |
|---|---|---|
| Alloy Wheels | GD.1 | 2 |
| Tyres | GD.2 | 2 |
| Spare Wheel & Tyre | GD.3 | 2 |
| Winter Tyres | GD.4 | 5 |
| Wheel/Tyre Assembly Balancing | GD.5 | 6 |

## GD.1 - ALLOY WHEELS

The 4 bolt fixing cast aluminium alloy wheels are styled by Lotus and manufactured by O.Z. of Italy. Two different wheel diameters are used, 15in and 16in, but due to corresponding changes in suspension components, the two types of wheel/tyre assembly are NOT interchangeable. The directional styling of the 15in wheels is NOT handed.

| | |
|---|---|
| Wheel size - 15in | 6½J x 15 H2E 60 |
| - 16in | 7J x 16 H2 ET 60 |
| Inset | + 60 mm |
| Wheel bolt torque | 80 - 88 Nm (59 - 65 lbf.ft) |
| Radial run-out at bead seat | 0.3 mm max. |
| Lateral run-out at rim flange | 0.3 mm max. |
| Max. out of balance moment | 20 gf.cm. |

**WARNING:** Ensure that only the specified wheels and wheel bolts are fitted to both front and rear axles. A smear of PBC grease on the centre spigot hole wll help prevent corrosion making wheel removal difficult, but do NOT allow the threads or seats of the wheel bolts to become contaminated with grease or the bolts may loosen in service.

## GD.2 - TYRES

The following tyres are the ONLY type approved by Lotus for all year round use.

| | |
|---|---|
| Type - 15in - N.A. | Michelin MXV-2 |
| - Turbo | Michelin MXX-2 |
| - 16in | Goodyear Eagle GS-D |
| Size - 15in - N.A. | 205/50 VR15 |
| - Turbo | 205/50 ZR15 |
| - 16in | 205/45 ZR16 |
| Pressure (cold) | |
| - 15in - N.A. (front & rear) | 2.2 bar (32 lb/in$^2$) |
| - Turbo (front & rear) | 1.8 bar (26.5 lb/in$^2$) |
| - 16in - Turbo (front & rear) | 1.8 bar (26.5 lb/in$^2$)* |

* For continuous speeds over 100 mph (160 km/h) increase pressures to: 2.0 bar (29.5 lb/in$^2$)

## GD.3 - SPARE WHEEL & TYRE

A 'compact' spare wheel is used on this vehicle to enhance luggage space, and, through its light weight, make mounting of the spare wheel easier for the owner.

| | |
|---|---|
| Spare wheel - type | Steel, one piece, 4 bolt fixing |
| - size | 3½J x 14 H2 |
| Spare tyre - type | Goodyear or Michelin Tex |
| - size | T105/70 R14 |
| Pressure | 4.2 bar (60 lb/in$^2$) |
| Maximum speed | 80 km/h (50 mph) |

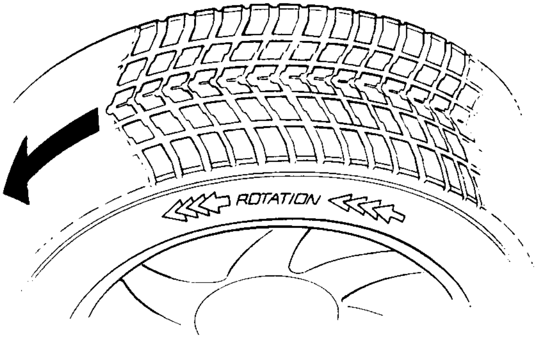
**WARNING:** This spare wheel is for EMERGENCY USE ONLY, and must be replaced with the normal wheel and tyre equipment as soon as possible. Only one spare wheel may be used on the vehicle at any one time. When the spare wheel is in use, differential tyre wear will be experienced, and the handling and braking characteristics of the car will be modified. It is therefore necessary to observe the following recommendations:

1. Less than moderate speeds and cornering loads should be employed, i.e. no more than half the car's potential relative to the pertaining road conditions subject to a recommended maximum speed of 80 km/h (50 mph) under the most favourable conditions.
2. When following other vehicles, Lotus recommend that observation is made of the U.K. Highway Code or American Safety Council guidelines for vehicle spacing; this advice applies equally to spare wheel usage as to all other motoring situations.
3. Spare wheel tyre pressure: 4.2 bar (60 lb/in$^2$).

The spare wheel, wheelbrace and jack are mounted beneath the boot floor. Pull up the centre section of the floor, and remove the spare wheel clamp bolt.

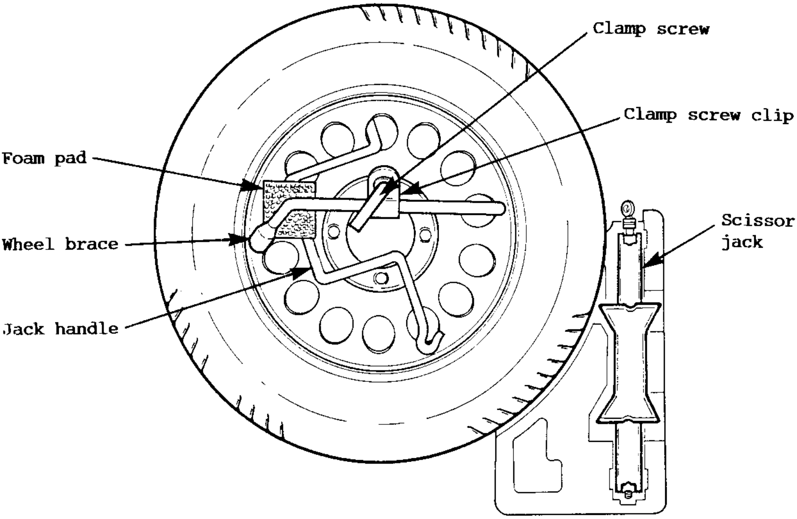
Before re-fitting the standard wheel, ensure that the mating face on both the wheel and hub is clean, and free from corrosion; otherwise a wheel vibration and/or loosening of the wheel bolts may occur.

**Note: Directional Tread.** The Goodyear 'Eagle GS-D' tyres used on cars with 16in wheels, have a preferred direction of rotation which is indicated both by an arrow on the tyre sidewall, and by the tread pattern itself as shown in the illustration. The tyre is safe to use in the non-preferred direction, and doing so will result only in a marginally reduced wet weather performance. However, this condition should not be retained for excessive periods, and it is recommended that the tyre is refitted to achieve the correct condition of preferred rotation at the earliest opportunity.

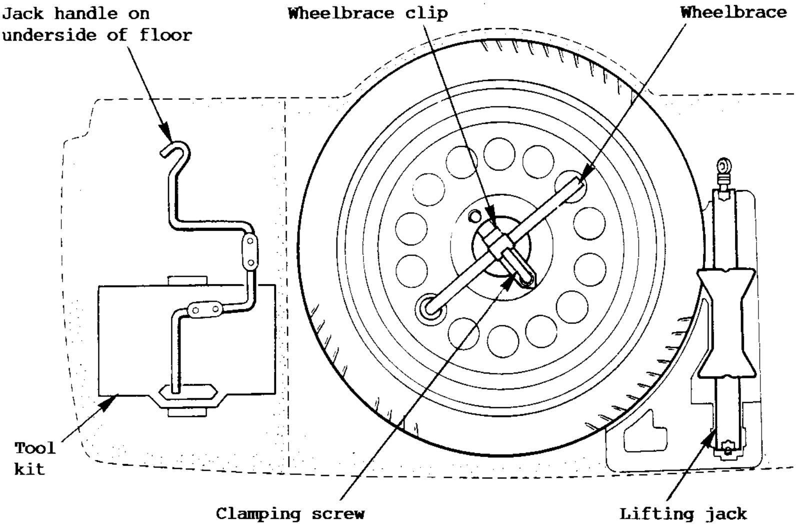


Always restow the spare wheel and wheel changing equipment in their correct locations to prevent insecure items causing damage to other components or to the body: Place the spare wheel into the boot floor recess with the outside of the wheel downmost, and a wheelbolt hole positioned over the securing thread hole in the body. Two types of spare wheel retention have been used. Early cars stowed the jack handle together with the wheelbrace in the spare wheel dish:

Early type spare wheel stowage


Clamp screw
Clamp screw clip
Foam pad
Scissor jack
Wheel brace
Jack handle

Later type spare wheel stowage


Jack handle on underside of floor
Wheelbrace clip
Wheelbrace
Tool kit
Clamping screw
Lifting jack

Lay the jack handle into the wheel, with the handle through the foremost wheel vent hole; fit the wheelbrace through the clamp screw clip; fit the clamp screw through the wheelbolt fixing hole, and start into its thread; before tightening the clamp screw, fit the foam pad between the jack handle and wheelbrace as shown; tighten the clamp screw.

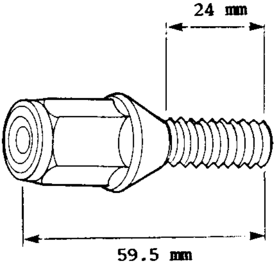
On later cars, the jack handle is stowed in clips on the underside of the left hand boot floor. Fit the clamping screw through the wheelbrace clip, and with the wheelbrace positioned as shown in the diagram, with the socket end fed into one of the wheel vent holes, secure the wheel and wheelbrace. and the jack into its moulded housing.

## GD.4 - WINTER TYRES (**NOT USA vehicles**)

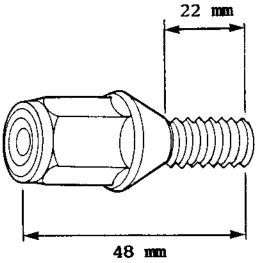
Winter tyres provide enhanced performance in snow and in icy conditions, but cannot be expected to match the exceptional performance levels of the standard equipment tyres under all other conditions which may be encountered. Winter tyres should not therefore be used as a 'year round' fitment.

Michelin X M+S 185/60 x 14 winter tyres, with or without studs, may be fitted only in complete car sets, (NOT to USA vehicles) using the specified 14in. steel wheels **AND SHORTER WHEEL BOLTS (A089G6009F).** When refitting the standard alloy wheels, the standard (longer) wheel bolts must be used.

Standard (alloy wheel) bolts
A100G6005F - Chrome plated



Winter wheel bolts
A100G6009F - Black finish



| | |
|---|---|
| Winter wheel - type | Steel, 4 bolt fixing |
| - size | 6J x 14 |
| - part number | A100G6008F |
| Wheel bolt - part number | A100G6009F (16 off) |
| - torque | 80 - 88 Nm (59 - 65 lbf.ft) |
| Winter tyre - type | Michelin X M+S, with or without studs |
| - size | 185/60 x 14 |
| - pressure (cold) | 2.0 bar (29 lb/in$^2$) |
| Speed limitation - without studs | 118 mph (190 km/h) |
| - with studs | see table |

For tyres without studs, a maximum speed of 118 mph (190 km/h) must be observed. If studded tyres are fitted, in countries that permit their use, further speed restrictions will apply, and a warning sticker must be applied to the back of the vehicle by the tyre fitting depot. Details of the speed restrictions for studded tyre usage in European countries, are listed below.

Limitations on use of **studded** winter tyres:

| Country | Period | Max. Speed km/h (mph) | |
|---|---|---|---|
| | | Normal Roads | Motorways |
| Austria | 15th Nov - 7th April | 80 (50) | 100 (62) |
| Belgium | 1st Nov - 31st March | 60 (37) | 90 (56) |
| Denmark | 1st Oct - 30th April | 80 (50) | 100 (62) |
| Finland | 1st Oct - 30th April | 80 (50) | 120 (75) |
| France | 15th Nov - 15th March | 90 (56) | 90 (56) |
| Germany | NOT PERMITTED | - | - |
| Holland | NOT PERMITTED | - | - |
| Italy | 15th Nov - 15th March | 90 (56) | 120 (75) |
| Norway | 15th Oct - 30th April | 80 (50) | 90 (56) |
| Switzerland | 1st Nov - 31st March | 80 (50) | NOT PERMITTED |
| Sweden | 1st Oct - 30th April | 70 (43) | 110 (68) |
| U.K. | NOT PERMITTED | - | - |

## GD.5 - WHEEL/TYRE ASSEMBLY BALANCING

Before balancing a wheel with a used tyre, ensure that any 'parking' flatspot is eradicated by running the car for several miles to warm the tyre to normal running temperature.

Wheel/tyre assemblies should be balanced at the recommended inflation pressure, off the car, using equipment which measures static and dynamic error. It is essential that the wheel is located using the 56.56 - 56.64 mm centre spigot hole, or by back coning. Do not locate using the wheel bolts.

Balance Specification

| | |
|---|---|
| Acceptable balance error - inside rim (static) | 15 g |
| - outside rim (dynamic) | 20 g |
| Maximum balance weight permissible - inside rim | 70 g |
| - outside rim | 60 g |

After balancing 'off car', it is preferable to correct the balance with the wheel refitted to the car.

| | |
|---|---|
| Acceptable balance error | 10 g |
| Permissible 'on car' correction | 20 g |

If an error of more than 20 g is recorded 'on car' after balancing the assembly 'off car', then either a procedure error is indicated (re-balance 'off car'), or there is a serious imbalance of other rotating components (e.g. brake disc, hub, etc.).

# STEERING

## SECTION HC - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | HC.1 | 2 |
| PAS Fluid Check & Oil Change | HC.2 | 4 |
| Steering Wheel & Column Assembly | HC.3 | 5 |
| Outer & Inner Ball Joints & Gaiters | HC.4 | 10 |
| PAS Pump & Testing Procedure | HC.5 | 11 |
| Steering Rack Assembly Removal/Replacement | HC.6 | 13 |
| PAS Rack Assembly Seal & Bush Replacement | HC.7 | 14 |
| Manual Rack Assembly Adjustment & Bush Replacement | HC.8 | 16 |

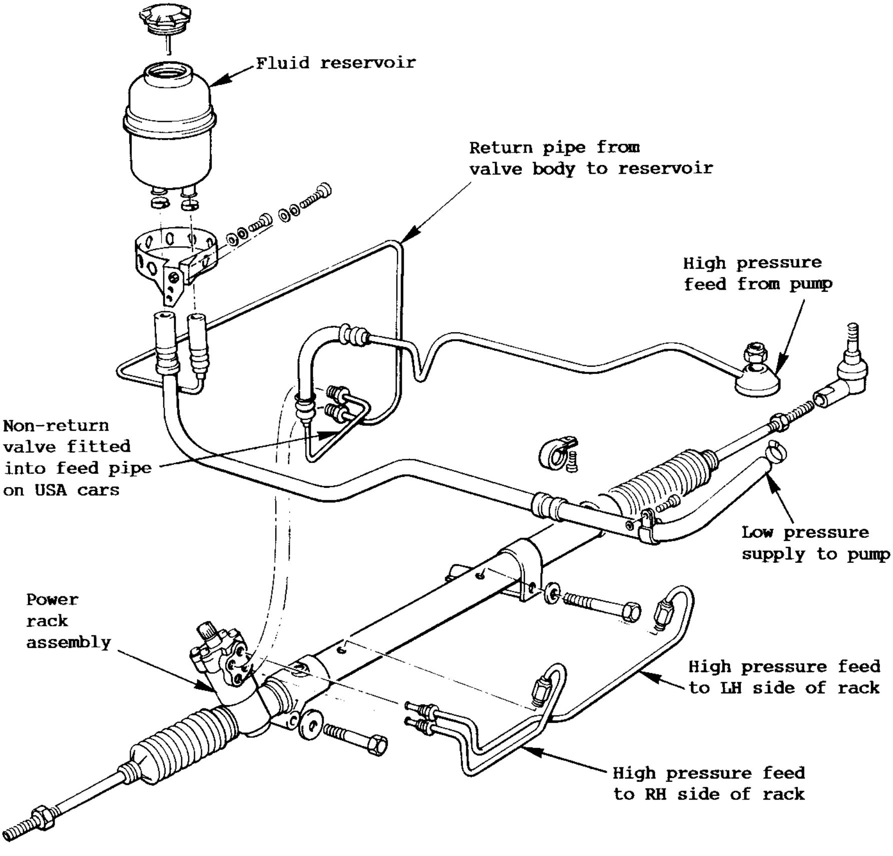
## HC.1 - GENERAL DESCRIPTION

The steering system comprises an upper column assembly, fixed on cars with S.I.R., and tilt adjustable on cars without, both types being collapsible in the event of vehicle frontal collision, and a manual or power assisted rack and pinion assembly.

The rack and pinion assembly is secured rigidly to the chassis front crossmember by two fixing bolts, and connects with each front hub steering arm via ball jointed track rods. The constant ratio steering rack assemblies are geared for 3.0 (manual) or 2.7 (power) turns lock to lock.

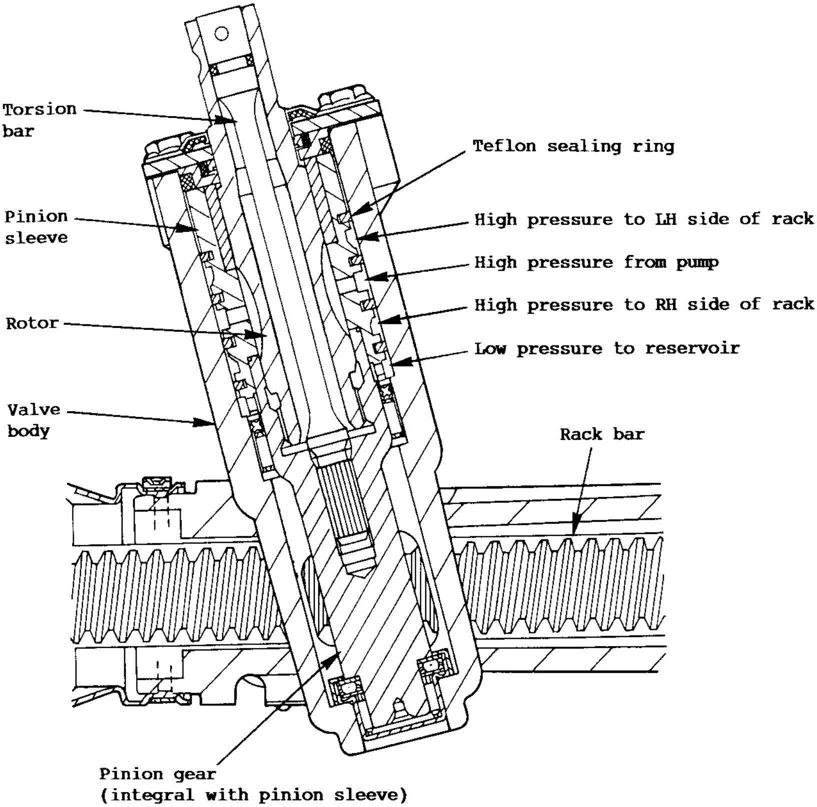
### Power Assisted Steering (PAS)

The PAS system uses a hydraulic pump, mounted on the front side of the engine driven by multi-vee belt from the crankshaft, to supply oil to the valve body of the steering rack, which distributes hydraulic pressure to either side of a piston on the steering rack to lessen load at the steering wheel. A reservoir for the hydraulic fluid is mounted at the right hand rear of the engine bay.


Fluid reservoir
Return pipe from valve body to reservoir
High pressure feed from pump
Non-return valve fitted into feed pipe on USA cars
Low pressure supply to pump
Power rack assembly
High pressure feed to LH side of rack
High pressure feed to RH side of rack

The steering rack assembly comprises a steel tube which houses the steering rack bar, with an aluminium alloy housing fixed at one end, which supports the pinion and valve body assembly. Each end of the rack tube is hydraulically sealed to the sliding rack bar by neoprene rings, and a piston at the centre of the bar divides the tube into two hydraulic chambers, with each chamber linked to the valve body by steel pipes.

The valve body, which is integral with the rack housing, contains three main elements: a pinion sleeve, which consists of a cylindrical sleeve fitted with teflon sealing rings to divide the hydraulic circuits, and an integral pinion gear which engages with the rack teeth; a torsion bar which runs down the middle of the pinion sleeve to connect the steering column to the pinion gear; and a rotor, which is secured together with the top of the torsion bar to the steering column, and rotates within the pinion sleeve to control the hydraulic ports. The valve body is provided with four hydraulic connections:


Torsion bar
Teflon sealing ring
Pinion sleeve
High pressure to LH side of rack
High pressure from pump
High pressure to RH side of rack
Rotor
Low pressure to reservoir
Valve body
Rack bar
Pinion gear
(integral with pinion sleeve)

- high pressure input from the pump
- low pressure return to the reservoir
- high pressure output to the left hand side of the rack piston
- high pressure output to the right hand side of the rack piston

When no torque is applied to the steering wheel, all four ports are interconnected so that oil from the pump flows through the valve body and back to the reservoir, and to both of the rack housing hydraulic chambers to apply an equal pressure to both sides of the rack piston.

When the steering wheel is turned, the rotor is turned by the column, but the rotation of the pinion sleeve is governed by the steering resistance at the road wheels, and the subsequent twist of the torsion bar. Thus the angular displacement between the rotor and pinion sleeve is dependent on the steering resistance and subsequent torque. As the torque (and angular displacement) increases, one of the output ports to the rack is progressively biased towards the low pressure return connection to the reservoir, whilst the other output port is biased towards the high pressure feed from the pump. In this way, a pressure differential is created between the two rack chambers, which tends to move the piston and provide steering assistance. When the input torque at the steering wheel is reduced, the angular displacement between the rotor and pinion sleeve is reduced so that the pressure balance tends to be restored, and steering assistance lessened. The same sequence happens when the wheel is turned in the opposite direction, and a pressure differential is created in the reverse sense.

The maximum angular displacement between rotor and pinion sleeve is limited mechanically to prevent excessive torque being applied to the the torsion bar, and to provide a mechanical link in the unlikely event of a torsion bar failure. Manual control of the steering would thus be retained, albeit with a small amount of 'lost motion'.

The engine driven vane type hydraulic pump, incorporates a pressure relief valve to control maximum pressure when the rack reaches its lock stops, and steering torque is still applied. The output of the pump is designed to fall off with increasing pump speed, in order to provide a measure of 'speed sensitivity', with greater power assistance being provided at low engine speed for parking manoeuvres etc., and less assistance at high speed. A pressure switch in the output side of the pump, senses when a high pump pressure is developed (with corresponding engine load), and signals the engine management ECM to increase the opening of the idle air control valve to maintain idle speed and prevent stalling.

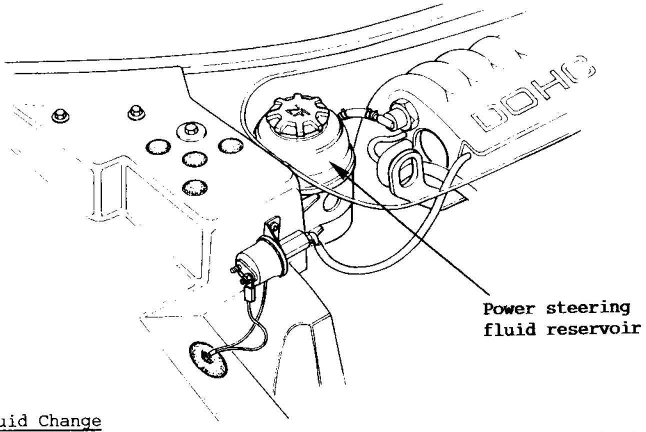
## HC.2 - PAS FLUID CHECK & OIL CHANGE PROCEDURE

### Recommended Hydraulic Fluid

The ONLY approved fluids for use in the power steering hydraulic system are:
Nippon Oils 'Besco A.T.F. - Dexron': Lotus part number A100H6088V
G.M. Power Steering Fluid: Lotus part number B100E6088V

### Fluid Level Check

The power steering reservoir is located at the right hand rear of the engine bay, secured to the spring turret on the chassis. At every vehicle service, clean the cap and top of the fluid reservoir before unscrewing the cap and inspecting the fluid level shown on the dipstick integral with the cap. The two marks on the dipstick correspond to the correct hot level (top mark - use when car has been driven several miles, and the reservoir is hot to the touch), and to the correct cold level (lower mark). Top up if necessary using ONLY the approved fluid (see above).



Hydraulic Fluid Change

The power steering oil should be changed at intervals specified in the Maintenance Schedule (see section O). To change the fluid, proceed as follows:

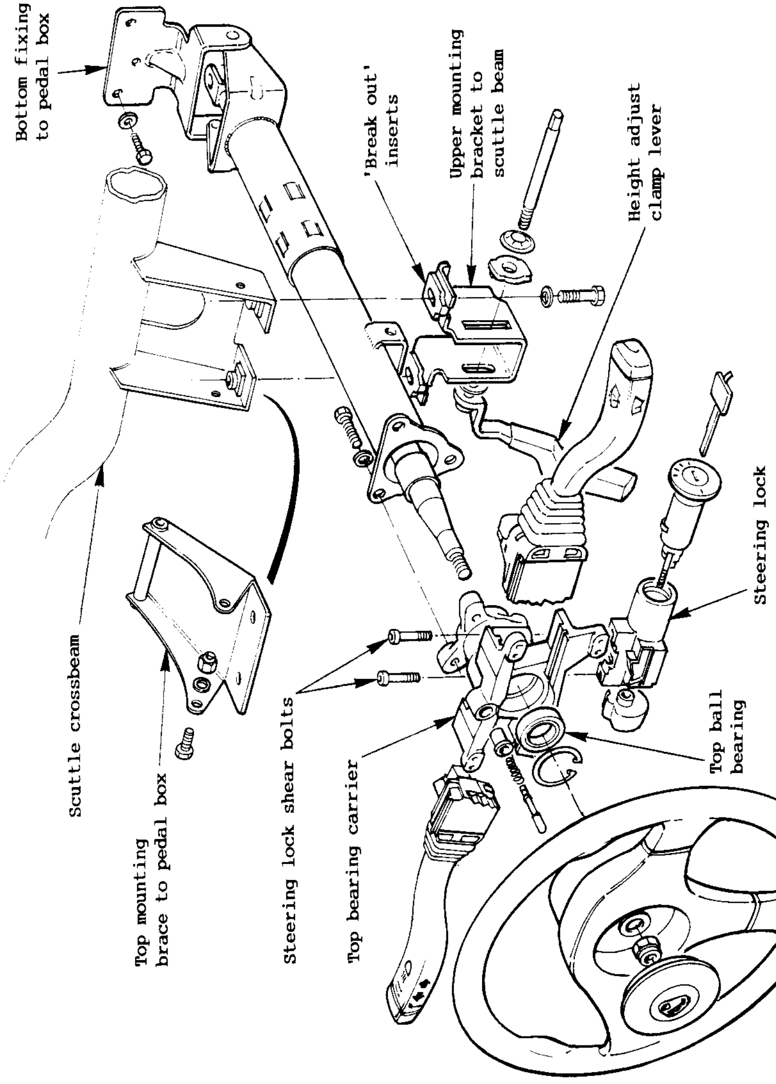
- Drain the fluid by removing the reservoir cap and disconnecting the high pressure feed and low pressure return pipes from the valve body on the steering rack (i.e. NOT the two pipes from valve body to rack housing), and collecting the oil.
- When the oil has drained thoroughly, refit the two pipes to the rack, torque tightening to: High pressure feed (upper, M14); 19 - 23 Nm (14 - 17 lbf.ft)
  Low pressure return (lower, M16); 19 - 23 Nm (14 - 17 lbf.ft)
- Fill the reservoir with new fluid, trip the inertia switch to prevent the engine starting, and crank the engine in short bursts whilst turning the steering slowly from lock to lock. Keep the reservoir topped up during this procedure, and on no account allow to fall sufficiently for air to enter the system while the engine is being cranked, or the pump may be damaged. Continue with this procedure until there is no evidence of air bubbles appearing in the reservoir.
- Top up the reservoir to the cold mark on the dipstick.
- Reset inertia switch, run engine, operate steering and inspect for leaks and correct power steering operation.

## HC.3 - STEERING WHEEL & COLUMN ASSEMBLY

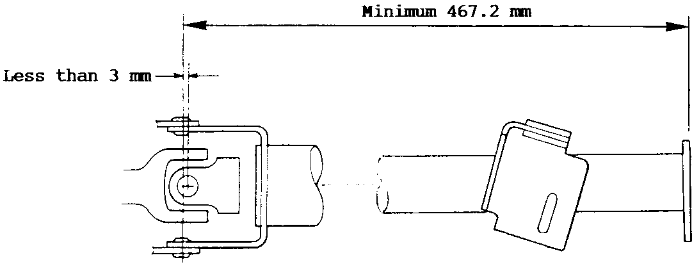
Two types of upper steering column are used on the Elan; a tilt adjustable column for markets outside the USA, and a non-adjustable version with S.I.R. (Supplementary Inflatable Restraint) on USA vehicles. The following section applies only to non-SIR cars. Any work on USA vehicles with SIR, requires that rigorous safety precautions be taken, which are fully detailed in a separate manual 'Section WB' part number E100T0327J. Do not attempt any work on an SIR type steering wheel or column without reference to section WB.

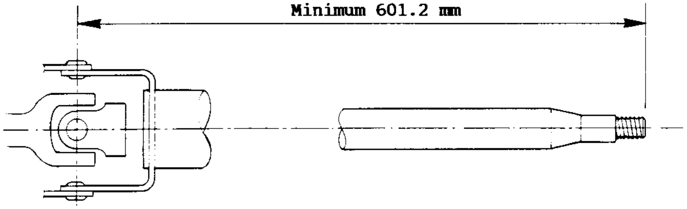
If the vehicle is involved in an accident, the collapsible steering column should be carefully inspected and renewed if any telescoping has occurred. Perform the following checks, removing the steering wheel and/or column shrouds first if necessary:

1. Outer column:
   - Measure the overall length of the outer column as shown in the diagram.
   Minimum length = 467.2 mm
   Replace the column assembly if outside specification.


Bottom fixing to pedal box
Scuttle crossbeam
Top mounting brace to pedal box
Steering lock shear bolts
Top bearing carrier
'Break out' inserts
Upper mounting bracket to scuttle beam
Height adjust clamp lever
Steering lock
Top ball bearing

Non-USA type height adjustable column shown





- Remove the column shrouds, loosen the column to scuttle beam fixing bolts and check that the two alloy 'break out' inserts are securely attached to the column flange.

2. Inner column:
   - Check that the centreline of the u/j at the lower end of the column is within 3 mm of the pivot axis of the outer column lower bracket. If greater than 3 mm, replace the column assembly.
   - Measure the overall length of the inner column.
   Minimum length = 601.2 mm
   Replace the column assembly if outside specification.

Steering Wheel Removal (Non-SIR)

1. Press the centre horn pad and turn counterclockwise to release from the bayonet type fixing.

2. Remove the nut and washer retaining the steering wheel and mark the reletive positions of the wheel and inner column to aid refitting.

3. Pull the wheel off the column using minimum force. If necessary, use a suitable puller. For improved puller access: remove the foam ring and two socket head screws securing the horn push spring assembly; withdraw the spring assembly and disconnect the horn lead spade terminal.
   **DO NOT** apply excessive axial force to either the inner or outer column without the use of a steering wheel puller, or the mechanism retaining the telescopic length of the collapsible column may be overridden, necessitating column replacement.

Refit the steering wheel in the reverse order to removal, and torque tighten the steering wheel nut to 40 Nm (30 lbf.ft).

Upper Steering Column Removal (Non-SIR)

1. Remove the steering column shrouds and unplug the electrical connector blocks for the column switches, ignition switch and horn. Depress the plastic tabs, and slide out the two column switches.

2. Remove the pinchbolt securing the column upper u/j to the intermediate shaft.

3. Remove the two bolts securing the bottom of the column to the pedal box, and the two bolts securing the top of the column to the scuttle beam.

4. Withdraw the column assembly, pulling the upper u/j off the splines of the intermediate shaft.

5. If necessary, the inner column may be withdrawn from the outer after removing the circlip from the top end of the inner column.

6. If necessary, remove the three bolts securing the top bearing carrier to the outer column. Use a centre punch or chisel to remove the two steering lock shear bolts. Remove the circlip and press out the ball bearing from the carrier.

Column Replacement

Refit the column in the reverse order to removal noting the following points:

- When refitting the column top bearing carrier, do not omit the cushion spacer between the bearing and the shaft circlip.
- Fit new column lock shear bolts, and tighten until sheared.
- Torque tighten:
  column to pedal box fixings; 10 Nm (7.5 lbf.ft).
  column to scuttle beam; 15 Nm (11 lbf.ft).
  u/j to intermediate shaft; 40 Nm (30 lbf.ft) using Permabond A121.

Intermediate Column

A short intermediate shaft and two universal joints (u/js) are used to transmit the steering torque from the upper column assembly to the steering rack pinion shaft. The orientation of the two u/js in relation to each other is imoprtant, and affects the steering 'feel' and smoothness of steering effort.

The upper u/j is integral with the upper column, and the intermediate shaft will fit into the u/j in only one position due to a master spline, and a 'flat' machined to accomodate the pinch bolt. The lower u/j will fit onto the rack pinion shaft in only one position, as dictated by the pinch bolt groove. Fitment of the intermadiate shaft into the lower u/j provides the only method of setting joint orientation.

If removing the upper column assembly, remove the pinch bolt from the upper u/j. Joint orientation will then be retained. If the lower u/j is to be removed (e.g. rack assembly removal):

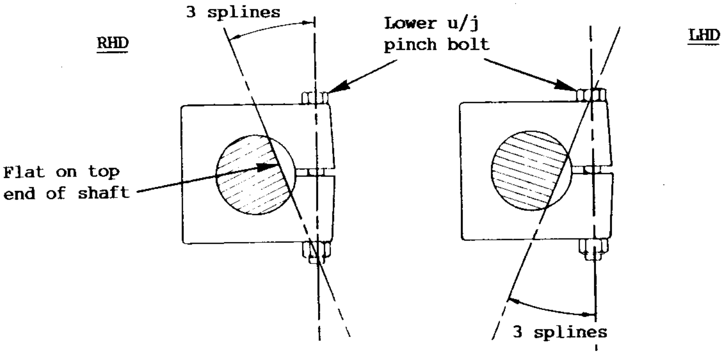
1. Disconnect the upper column from the intermediate shaft (see above).

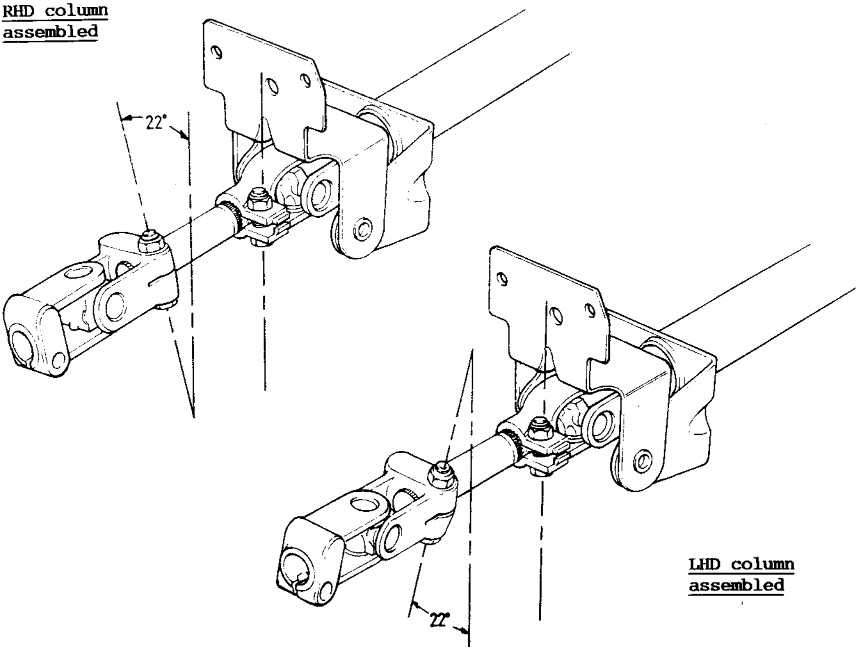
2. Release the pinch bolt securing the lower u/j shroud to the bulkhead, and withdraw the shroud over the intermediate shaft.

3. Release the pinch bolt securing the lower u/j to the pinion shaft, and rotate the shaft until the bolt may be removed and the joint withdrawn.

4. Re-assembly: If the intermediate shaft has been separated from the lower u/j, the orientation must be set on assembly:

Taking the axis of the pinch bolt which secures the lower u/j to the intermediate shaft as a datum, first set the shaft so that the flat on the splines at the **top** end of the shaft is parallel with the pinch bolt. Then turn the shaft 3 splines counterclockwise on RHD cars, or 3 splines clockwise on LHD cars, before inserting the shaft into the lower u/j. See diagrams. Fit the pinch bolt and tighten to 25 Nm (18 lbf.ft).


RHD
3 splines
Lower u/j pinch bolt
LHD
Flat on top end of shaft
3 splines



**RHD column assembled**

**LHD column assembled**

Note that u/j alignment on SIR cars is different to the LHD specification shown above. Refer to section WB.3 in the separate manual E100T0327J.

5. Fit the lower u/j onto the rack assembly pinion shaft with the pinch bolt axis aligned with the groove in the shaft. Fit the pinch bolt and torque tighten to 25 Nm (18 lbf.ft).

6. Fit the lower u/j shroud over the intermediate shaft and secure to the bulkhead.

7. Refit the upper column assembly (see above).

## HC.4 - OUTER & INNER BALL JOINTS & GAITERS

### Outer Ball Joints

The outer ball joints (track rod ends), are secured to the hub carrier steering arms by tapered ball pin shanks and nyloc nuts. The track rods are threaded into the ball joints, and provide a means of adjustment of toe-in.

Toe-in adjustment: To adjust the toe-in, hold each track rod end by the flats provided (22 mm) whilst releasing the locknut. Turn each track rod, using the flats provided (13 mm) an EQUAL amount, to adjust the effective track rod length as necessary. When adjustment is correct, hold the track rod end and tighten the locknut to 60 Nm (44 lbf.ft).

Ball joint replacement: If the ball joint gaiter is damaged, or if any play in the joint is discernible, the joint should be replaced. Before removing the joint, measure the length of thread protruding in order that the initial setting of the new joint may be approximately correct. Remove the nyloc nut, and use a ball joint splitter tool to seperate the joint from the steering arm. Release the locknut, and unscrew the joint from the track rod.

Screw the new joint onto the track rod to the position measured above, and fit the tapered ball pin into the steering arm. Fit a new nyloc nut (no washer) and torque tighten to 58 - 64 Nm (43 - 47 lbf.ft). Check and adjust toe-in and tighten locknuts as above.

### Rack Gaiters

Damaged rack gaiters should be replaced immediately to prevent loss of lubricant, dirt ingress and damage to the inner ball joints or rack assembly. To replace the rack gaiters, first remove the track rod ends, and then cut the gaiter clips before withdrawing the gaiters from the rack.

Before fitting new gaiters, examine the condition of the inner ball joints and replace if necessary (see below).

Fitting the non-pinion end gaiter: Fit the new gaiter into its location groove on the end of the rack housing, and secure with a new clip. Before fitting the gaiter clamp at the track rod, smear the groove in the rod with rubber grease to enable the track rod to be turned for tracking adjustment without damaging the gaiter.

Fitting the pinion end gaiter: Fit as for the non-pinion end gaiter, except that before fitting the large end clip, raise the driver's side of the vehicle to prevent the oil running out, and inject the rack teeth area with 0.14 litres of EP80 oil.

### Track Rod/Inner Ball Joint Assemblies

The track rods are integral with the inner ball joints, which are not adjustable or serviceable in any way. If any play is discernible in a joint, the track rod/ball joint assembly should be replaced in the following manner:

- Remove the steering rack assembly from the car (see section HC.6).
- Remove both rack gaiters.
- Each ball joint is threaded into the end of the rack bar, and is provided with flats to enable the joint to be turned. **It is most important that the pinion gear teeth are not allowed to provide the reaction torque when fitting or removing the inner ball joints.** i.e. hold one of the joints, whilst unscrewing the other, and use a soft jawed clamp to hold the rack across the surface of the teeth to unscrew the second joint.
- Fit the new joints in the reverse order to disassembly, tightening each joint to 72.5 Nm (54 lbf.ft) whilst not allowing the pinion gear teeth to bear any of the reaction load.
- Deform the tab ring into the slot provided on the rack body.
- Refit the rack gaiters as above.
- Refit steering rack assembly.

## HC.5 - PAS PUMP & TESTING PROCEDURE

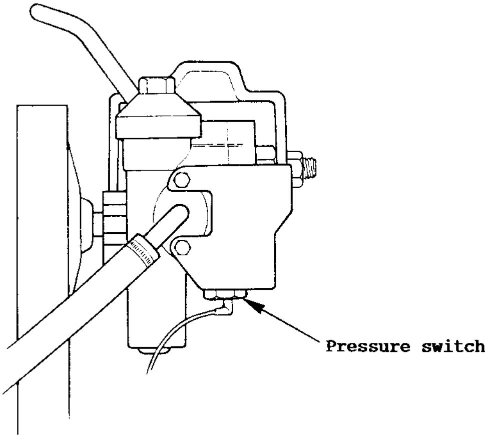
### Drive Belt

The 10 vane, constant displacment pump, is a non-serviceable unit mounted on the left hand front of the cylinder block, driven by multi-vee belt from the crankshaft. The drive belt should be tensioned to 65 ± 7 kgf (145 ± 15 lbf) using a Burroughs gauge. To adjust belt tension, slacken the pivot bolt securing the pump mounting bracket to the cylinder block, and the two bolts securing the adjuster strap. Swing the pump bracket to achieve the specified tension, and tighten the three bolts to 18 Nm (13 lbf.ft).

### Power Steering Pressure Switch (PSPS)

When a high torque is applied to the steering wheel, and a heavy load placed on the pump, a pressure switch in the outlet side of the pump, closes at about 40 kgf/cm$^2$ (570 lb/in$^2$) and signals the engine management ECM to open the idle air control valve and raise idle speed to prevent stalling. The air conditioning compressor (on cars so equipped) is also switched off when the power steering pressure switch (PSPS) closes.

**PAS pump viewed from front side**



To check that the PSPS is functioning, let the engine idle, and hold the steering against the left hand lock stop. The idle speed should increase. Switch on the air conditioning and repeat the test. The compressor should switch off, and the idle speed increase. If the system does not perform as specified, verify PSPS switching using a continuity meter across the switch terminals.

To replace the switch, first remove the radiator bottom hose for improved access, before unscrewing the switch from the underside of the pump body. Plug the hole immediately to reduce oil loss.

## Pressure Test

To check both the pump output, and the steering rack assembly seals for leakage, a test gauge T000T1085 is needed to measure the line pressure and flow rate in the output hose from the pump:

1. Disconnect the output pipe connection from the top of the pump, using a shop towel to collect any draining fluid, and fit the test gauge between the pump and the disconnected pipe. Top up the PAS reservoir if necessary.

2. Open the gauge valve fully, start the engine, and slowly close the gauge valve until a pressure of about 20 kgf/cm$^2$ (300 lbf/in$^2$) is registered. Run in this condition until the system reaches a normal running temperature of 50 - 60°C (120 - 140°F). If necessary, add fluid to the reservoir to bring the level up to the 'max' mark.

3. Raise engine speed to 1500 rpm. Briefly close the gauge valve fully and record the highest pressure reading. **NOTE:** Do not shut the valve for longer than 10 seconds because the fluid temperature will rise quickly, resulting in a false pressure reading. Briefly shut the valve twice more, and record the pressure readings.

   Specification: 80 - 85 kgf/cm$^2$ (1140 - 1200 lbf/in$^2$)

   If the pressures recorded are outside of specification, the pump should be replaced

4. With the gauge valve open, hold the steering against the left hand lock stop for a moment and record the maximum pressure, and then hold against the right hand lock stop and record the pressure.

   If readings are less than 80 kgf/cm$^2$ (1140 lbf/in$^2$), a leaking valve body seal or rack piston seal is indicated.

5. To check the flow rate, with engine speed held at 1300 rpm, adjust the gauge valve to achieve a pressure reading of less than 5 kgf/cm$^2$ (70 lbf/in$^2$), and measure the flow rate.

   Specification; 8 ± 0.75 litre/min.

   To check that the flow rate drops off at higher engine speed, raise to 3,500 rpm, re-adjust the gauge valve to achieve less than 5 kgf/cm$^2$ pressure, and measure the flow rate.

   Specification; 5 ± 0.75 litre/min.

   If either reading is out of specification, the pump should be renewed.

## Pump Replacement

The pump and mounting bracket may be withdrawn from beneath after releasing the compressor, anti-roll bar and bottom hose, or from above after removing the front topshell. Using the latter method:

1. Remove the front topshell (see section BK).

2. Disconnect both hoses/pipes from the pump and drain the fluid into a suitable container. Unplug the PSPS electrical connector.

3. Slacken the belt tension, release the bolts securing the pump to the mounting bracket, and remove the pump and pulley assembly.

4. If a new pump is to be fitted, use a suitable puller to withdraw the pulley from the old pump, and fit to the new pump using special tool T000T1030. Pull the pulley onto the pump shaft until the pulley boss is flush with the shaft end. **If the special tool is not used, damage may be caused to the pump internals.**

5. Refit the pump in the reverse order to removal, tensioning the belt as above. Tighten the outlet pipe banjo bolt.

## HC.6 - STEERING RACK ASSEMBLY REMOVAL/REPLACEMENT PROCEDURE

### Removal

1. From inside the driver's footwell, remove the pinchbolt securing the upper column to the intermediate shaft. Release the fixing bolts securing the upper column to the pedal box and scuttle, and separate the upper u/j from the column. Release the sealing shroud from the floor panel and remove over the intermediate shaft. Remove the pinch bolt securing the lower u/j to the rack pinion shaft and slide off the shaft.

2. Remove both front road wheels, and the track rod end nyloc nuts. Use a ball joint splitter tool to disconnect each track rod end from its steering arm.

3. Remove the engine bay underframe, and provide alternative support for the driver's side suspension raft before removing the raft top mounting bolt.

4. On PAS assemblies, disconnect the feed and return pipes (two larger diameter pipes) from the valve body, and collect the fluid. Plug the pipes and ports. Remove the longer of the two valve body to rack housing pipes, and plug the ports.

5. Release the two rack housing mounting bolts, withdraw the pinion housing from the chassis and slide the rack assembly towards the passenger side and then out from beneath.

### Replacement

Refit the rack in the reverse order to removal, noting the following points:

- On USA cars, fit foam rubber seal A100H0053 over the pinion shaft before fitting the rack assembly. After rack fitment, check that the chassis steering aperture is sealed.
- Tighten rack housing to chassis bolts to 120 Nm (89 lbf.ft).
- Fit the lower u/j onto the pinion shaft with the pinch bolt groove aligned, and torque pinch bolt to 25 Nm (18 lbf.ft).
- On PAS cars, tighten hydraulic connections on pipe between valve body and rack tube to 12 Nm (9 lbf.ft). Tighten feed (top, M14) and return (lower, M16) connections to 19 - 23 Nm (14 - 17 lbf.ft).
- Tighten track rod end to steering arm connections to 58 - 64 Nm (43 - 47 lbf.ft).
- On PAS cars, refill and bleed the hydraulic system (see HC.2).
- Adjust front wheel toe-in (see section CE).

## HC.7 - PAS RACK ASSEMBLY SEAL & BUSH REPLACEMENT

The only repairs that may be carried out on the steering rack assembly main components, is the fitment of replacement seals and non-pinion end rack bush, contained in the seal kit.

1. Remove the steering rack assembly from the car (see section HC.6) to a clean working area.

2. Remove the rack gaiters and track rods (see section HC.4).

3. Release the two screws securing the spring loaded plunger at the back of the rack (opposite the pinion housing), and remove the plunger assembly.

4. Pull off the pinion shaft dust seal and discard. Release the four bolts securing the pinion housing top plate, and remove the plate and shims. Carefully withdraw the complete valve/pinion assembly from the housing, and lay aside. Protect from dust and dirt.

5. At the non-pinion end of the rack tube, prise up the peening on the rack tube ring nut, and whilst holding the seal housing by the flats provided, unscrew the ring nut. Pull the rack bar and non-pinion end housing from the tubular steel rack housing. Slide the end seal housing from the rack bar.

6. Remove the locating screw securing the pinion end rack seal carrier into the rack tube. Tap the non-pinion end of the rack tube against a hardwood bench or similar to dislodge the pinion end seal carrier, and remove from the tube.

7. Pinion end rack seal carrier:
   - Prise off the cap, and remove the rack bar seal and tape bearing. Fit new parts from the seal kit and replace the cap.
   - Remove the sealing ring from the spigot end of the seal carrier, and fit the new seal inside the rack tube, against the shoulder.

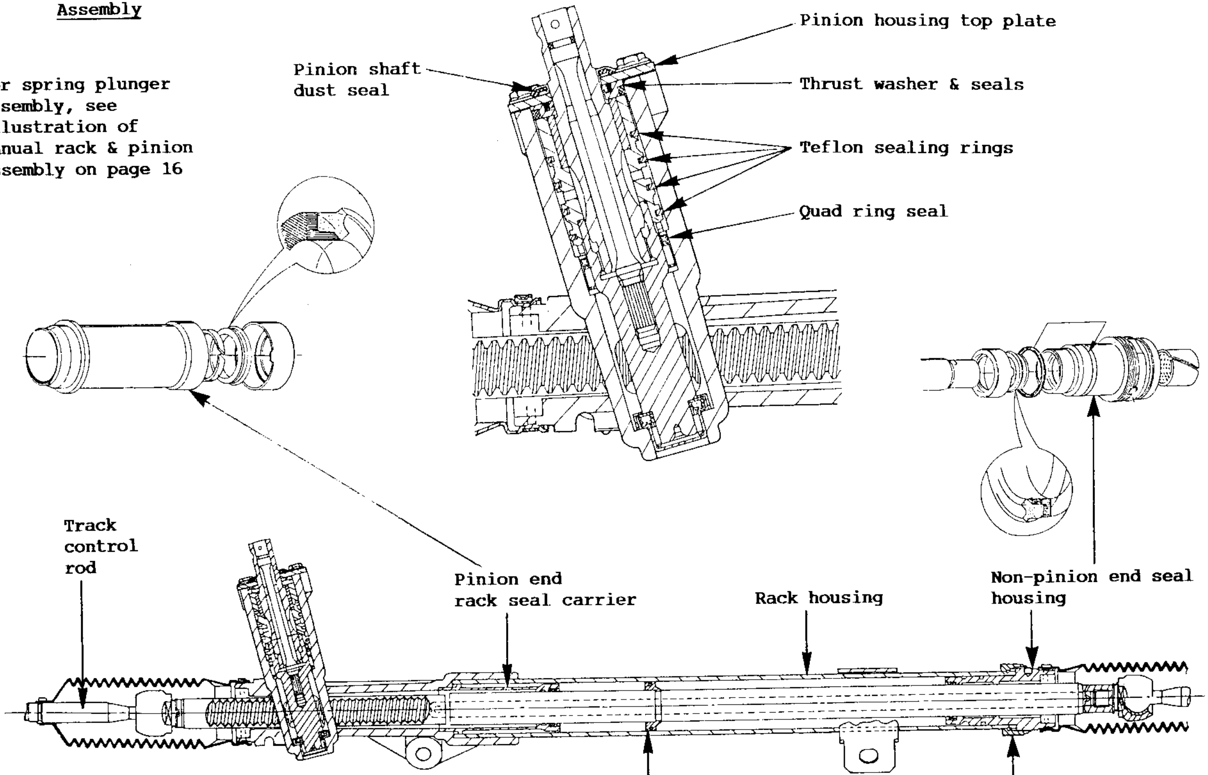
8. Fit new inner and outer piston ring seals to the rack piston. Lubricate the rack/rack tube with the specified hydraulic fluid, and carefully fit the pinion end seal carrier over the rack teeth and up to the rack piston. Lubricate the spigot end of the seal carrier, and insert the rack and seal carrier into the tube. Use the rack piston to seat the seal carrier into position, and retain by fitting the locating screw, with new sealing washer. Torque tighten to 14 Nm (10.3 lbf.ft), and stake the screw at three positions.

9. Non-pinion end housing:
   - Prise off the seal retaining cap, and discard the rack bar seal. Remove and discard the rack tube seal. Prise out the rack bar bush.
   - Fit a new bush, and new tube and rack bar seals. Refit the seal retaining cap.
   - Fit the housing into the end of the rack tube, apply Duralac jointing compound or similar to the ring nut threads, and screw on the ring nut. Hold the end housing whilst torque tightening the ring nut to 75 Nm (55 lbf.ft). Peen over the end of the nut into the housing hole.

10. To correctly position and centralise the rack, remove the blanking plug adjacent to the spring plunger housing, and insert a 4.7 mm rod, or special tool T000T1073 to engage the drilling in the back of the rack bar.

## Power Rack & Pinion Assembly

For spring plunger
assembly, see
illustration of
manual rack & pinion
assembly on page 16


Pinion shaft dust seal
Pinion housing top plate
Thrust washer & seals
Teflon sealing rings
Quad ring seal
Track control rod
Pinion end rack seal carrier
Rack housing
Non-pinion end seal housing
Rack piston
Rack tube ring nut

11. Valve/pinion assembly:
    - Pull the thrust washer and seals off the top end of the rotor. Remove the pinion sleeve sealing rings by carefully cutting through each of the four teflon rings.
    - Use special expander/guide tool T000T1072 to fit a new sealing ring into each of the four grooves, working from the bottom groove upwards.
    - Lubricate a new quad ring seal, and locate between the lower end of the pinion sleeve and the roller bearing.
    - Using the tapered guide tool T000T1071, insert the valve/pinion assembly into the housing, so that when the teeth are fully engaged, the pinch bolt groove on the rotor faces the pinion end of the rack tube.
    - Fit a new seal onto the outside of the thrust plate, and a new 'O' ring and step seal to the inside of the plate. Use the tapered guide tool T000T1071 to fit the plate into position over the top of the rotor.
    - Press down on the thrust washer, and measure the distance between thrust washer top surface and pinion housing top face. This should be between 0.1 mm (minimum) and 0.8 mm (maximum). Add 0.05 to 0.1 mm to this figure, and select a shim pack of that thickness to fit between the pinion housing and top plate. Shims are available in thicknesses of 0.05, 0.15 and 0.25 mm.
    - Fit the shims onto the thrust washer, followed by the top plate and four fixing screws. Torque tighten to 10 Nm (7.5 lbf.ft).
    - Smear the lip of a new dust seal with rubber grease, fit over the top of the rotor and press into position leaving a gap of approx. 1 mm between the metal shield and the pinion housing top plate.

12. Remove the rack bar centralising tool, but do not refit the blanking plug at this stage.

13. Refit the spring plunger assembly into the back of the rack housing using a new sealing ring, and torque tighten the fixing screws to 23 Nm (17 lbf.ft). Check the adjustment of the plunger: with the rack centralised, release the locknut, and tighten the adjusting screw until firm resistance is felt. Back off the adjusting screw the minimum amount necessary so that when the rack is moved through its full travel (by turning the pinion shaft), no increase in resistance (tight spot) is found. If it is necessary to back off the screw more than 1/8th of a turn to achieve this, the rack teeth are badly worn, and the complete assembly should be replaced. Hold the adjusting screw and tighten the locknut to 23 Nm (17 lbf.ft).

14. Refit the track rods and rack gaiters (see section HC.4).

15. Inject into the rack and pinion area, via the centralising screw hole, 0.14 litres of EP 80 oil. Refit the blanking plug, and torque tighten to 8 Nm (6 lbf.ft).

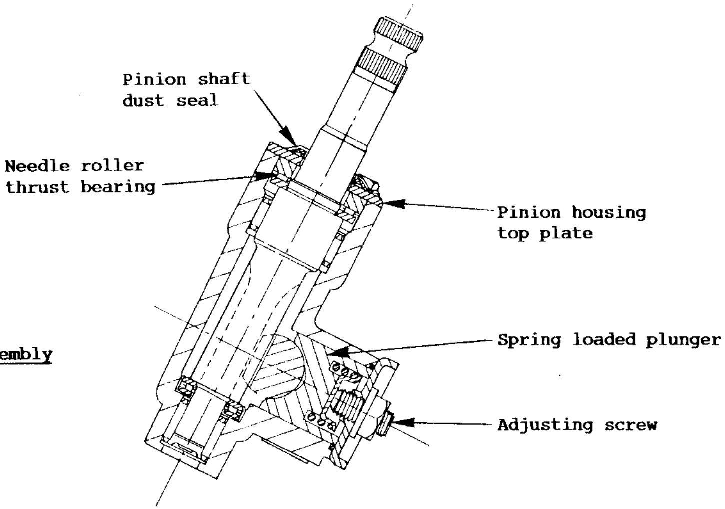
16. Refit the steering rack assembly to the car (see section HC.6).

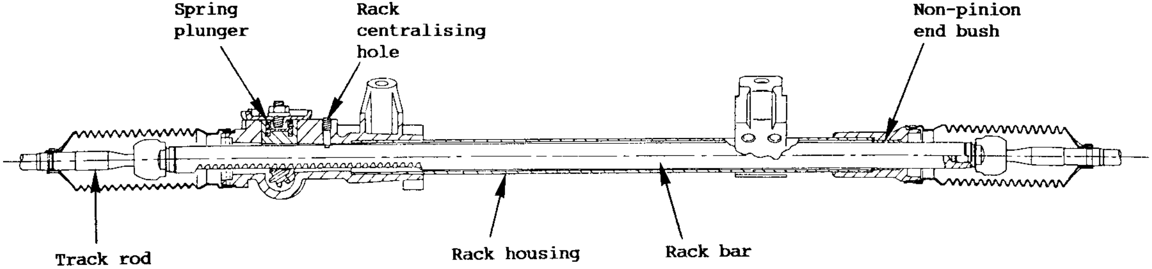
## HC.8 - MANUAL RACK ASSEMBLY SEAL & BUSH REPLACEMENT

The only repairs that may be carried out on the steering rack assembly main components, is the replacement of the non-pinion end rack bush, and the adjustment of the rack spring plunger.

1. Remove the steering rack assembly from the car (see section HC.6) to a clean working area.

Manual Rack & Pinion Assembly


Pinion shaft dust seal
Needle roller thrust bearing
Pinion housing top plate
Spring loaded plunger
Adjusting screw


Spring plunger
Rack centralising hole
Non-pinion end bush
Track rod
Rack housing
Rack bar

2. Remove the rack gaiters and track rods (see section HC.4).

3. Remove the blanking plug adjacent to the plunger housing at the back of the unit, centralise the rack, and insert a 4.7 mm rod, or special tool T000T1073 to engage the drilling in the back of the rack bar. Mark the position of the pinion shaft relative to the housing to aid re-assembly. Remove the centralising tool.

4. Release the two screws securing the spring loaded plunger at the back of the rack (opposite the pinion housing), and remove the plunger assembly.

5. Pull off the pinion shaft dust seal and discard. Release the four bolts securing the pinion housing top plate, and remove the plate and shims. Carefully withdraw the pinion shaft and top thrust bearing, and lay aside.

6. Withdraw the rack from the housing.

7. Prise out the teflon bush from the non-pinion end of the rack housing, and fit a new bush into position, after first heating the bush in boiling water to increase its flexibility and speed recovery time.

8. Thoroughly clean the rack before smearing the whole length with Shell Retinax A, or equivalent grease, and apply about 30g of grease to the rack teeth area. Fit the rack into the housing, and fit the centralising tool as in (3).

9. Insert the pinion shaft into the housing, and engage the pinion gear teeth with those on the rack so that the mark made in operation (3) is correctly aligned. Apply Shell Retinax A, or equivalent grease into the top of the pinion housing before fitting the thin thrust washer, needle roller thrust bearing, and thick thrust washer.

10. Press down on the thrust washer and measure the distance between the top surface of the thrust washer and the pinion housing top face. This should be between 0.34 mm (minimum) and 0.84 mm (maximum). Add 0.05 to 0.1 mm to this figure, and select a shim pack of that thickness to fit between the pinion housing and top plate. Shims are available in thicknesses of 0.05, 0.15 and 0.25 mm.

11. Pack the top of the pinion housing with grease. Fit the top plate shim pack and top plate, and retain with the four screws. Torque tighten to 20 Nm (15 lbf.ft).

12. Remove the centralising tool and refit the blanking plug, tightening to 8 Nm (6 lbf.ft).

13. Smear the lip of a new pinion shaft dust seal with rubber grease, fit over the top of the shaft and press into position leaving a 1 mm gap between the metal shield and the pinion housing top plate.

14. Refit the spring plunger assembly into the back of the rack housing using a new sealing ring, and torque tighten the fixing screws to 23 Nm (17 lbf.ft) Check the adjustment of the plunger: with the rack centralised, release the locknut, and tighten the adjusting screw until firm resistance is felt. Back off the adjusting screw the minimum amount necessary so that when the rack is moved through its full travel (by turning the pinion shaft), no increase in resistance (tight spot) is found. If it is necessary to back off the screw

more than 1/8th of a turn to achieve this, the rack teeth are badly worn, and the complete assembly should be replaced. Hold the adjusting screw and tighten the locknut to 23 Nm (17 lbf.ft).

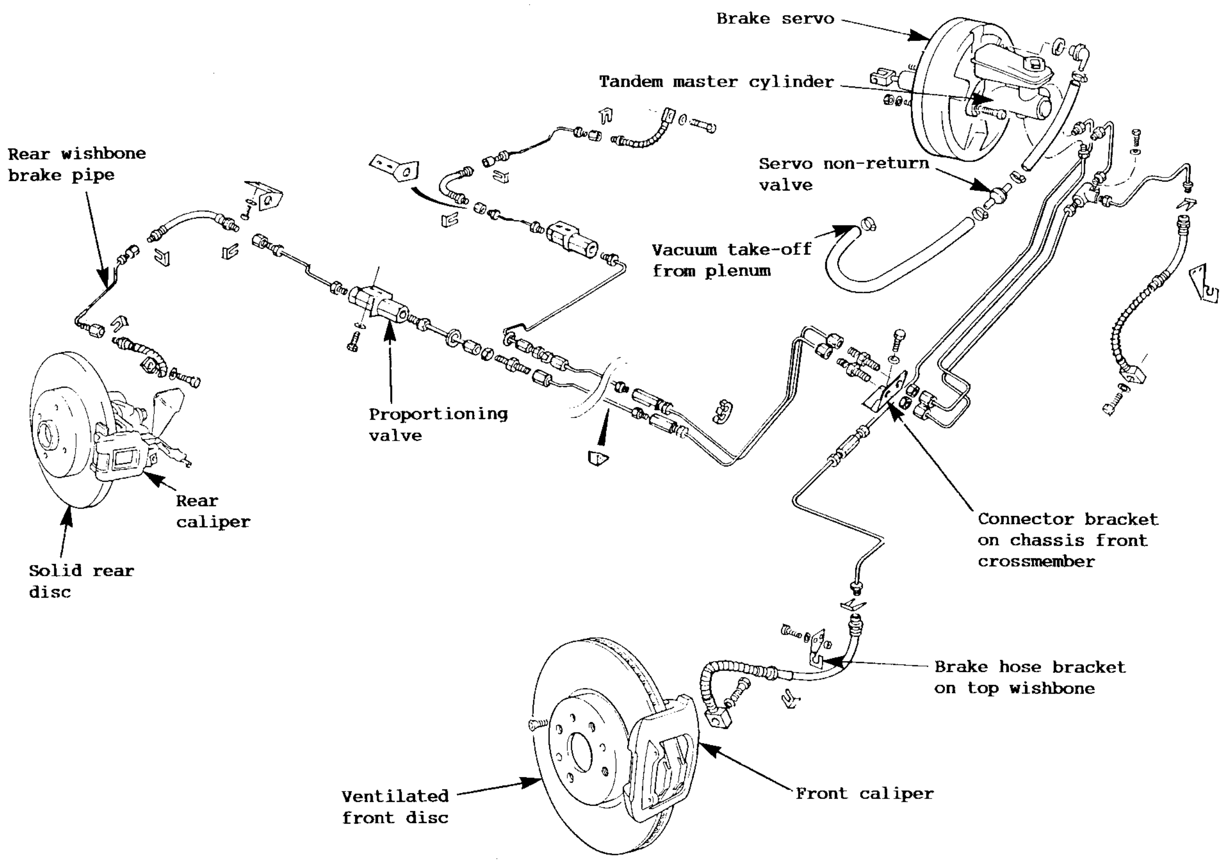
13. Refit the track rods and rack gaiters (see section HC.4).

14. Refit the steering rack assembly to the car (see section HC.6).

# BRAKES

## SECTION JE - ELAN

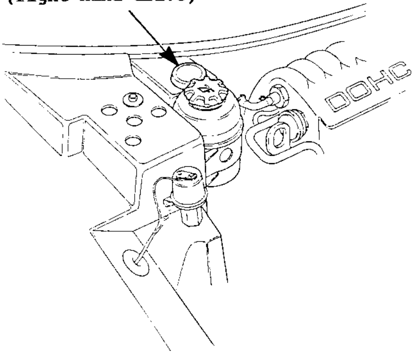
| | Sub-Section | Page |
|---|---|---|
| General Description | JE.1 | 3 |
| Front Brake Pad Replacement | JE.2 | 4 |
| Rear Brake Pad Replacement | JE.3 | 5 |
| Parking Brake Mechanism | JE.4 | 7 |
| Front Caliper Overhaul | JE.5 | 9 |
| Rear Caliper Overhaul | JE.6 | 11 |
| Brake Discs | JE.7 | 15 |
| Brake Servo Unit | JE.8 | 15 |
| Master Cylinder | JE.9 | 17 |
| Proportioning Valves | JE.10 | 17 |

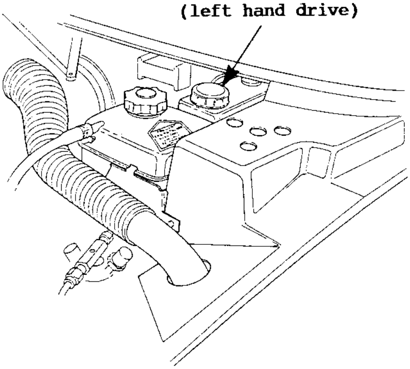

Brake servo
Tandem master cylinder
Servo non-return valve
Vacuum take-off from plenum
Connector bracket on chassis front crossmember
Brake hose bracket on top wishbone
Front caliper
Ventilated front disc
Proportioning valve
Rear wishbone brake pipe
Rear caliper
Solid rear disc

## JE.1 - GENERAL DESCRIPTION

The braking system comprises a tandem master cylinder and direct acting vacuum servo unit operating single piston sliding calipers for each wheel, with ventilated front, and solid rear discs.

The hydraulic circuit is diagonally split (LH front/RH rear, and RH front/LH rear) for independent operation from the separate compartments of the tandem master cylinder, with separate hydraulic lines feeding each caliper. A brake pressure proportioning valve is incorporated into each of the rear brake lines in order to control rear brake line pressure under heavy braking, and reduce the likelihood of rear wheel lock up. A single divided reservoir serves both compartments of the tandem master cylinder, and is provided with a low fluid level warning switch, which operates a fascia mounted tell tale lamp.


**Brake fluid reservoir (right hand drive)**


**Brake fluid reservoir (left hand drive)**

Single piston sliding calipers are used at each wheel. The caliper body is supported on two hardened steel sleeves, which allow the caliper free lateral movement. When the brakes are applied, hydraulic pressure in the caliper cylinder, forces the piston outwards and the caliper body inwards, resulting in the brake pads being clamped to the disc, producing the required friction.

The parking brake lever connects, via a compensating link (to equalise the pull applied to each cable), to two cables, one leading to each rear caliper. Each cable operates a lever on the caliper which turns an actuating screw (quick thread) inside the caliper cylinder, forcing the piston against the pad and disc and applying the brake. A self adjusting mechanism within the cylinder, takes the form of a spring clutch wrapped around the piston 'nut' in which the parking brake actuator screw operates. On application, the one way spring clutch locks the nut to the piston, so that the piston is forced to move axially when the actuating screw is turned. On release, a 'piston retainer' outboard of the piston hydraulic seal, exerts sufficient grip on the piston to prevent it being drawn back by the mechanism. This compels the spring clutch to release the nut, so that the actuator screw and nut turn as one, as the screw returns to its start position. This results in any free play being automatically taken up, with the nut starting from a position further along the thread the next time the parking brake is applied. Operating the piston hydraulically, via the footbrake, has a similar effect, with the piston moving outwards and the nut being allowed to turn within it by the spring clutch. This automatically adjusts the parking brake mechanism ready for the next application.

## JE.2 - FRONT BRAKE PAD REPLACEMENT

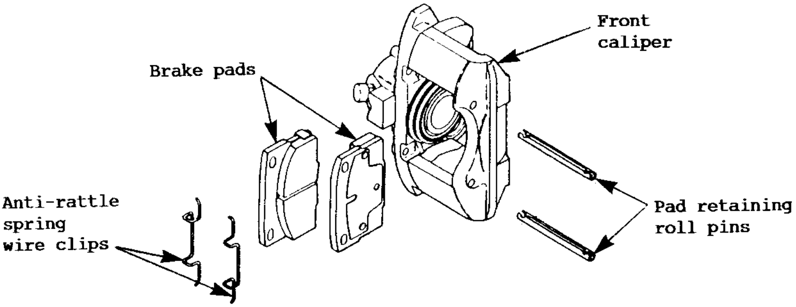
Pad thickness may be checked without disturbing the caliper.
Standard pad thickness - 15.5 mm (0.6 in.)
Minimum pad thickness - 2.0 mm (0.08 in.)

### To Replace Front Pads

1. Remove Fluid: If well worn pads are to be replaced with new, syphon brake fluid from the master cylinder reservoir to leave it approx. one third full.

2. Remove Pins: Use a pin drift and hammer to knock out the two pad retaining roll pins, from inside to outside. Remove the wire spring from each pad.

3. Withdraw Pads: Pull the caliper outwards, and withdraw the outboard pad. Push the caliper inwards, and withdraw the inboard pad.



4. Push Back Piston: The piston must be pushed fully back into its bore to provide clearance in the caliper for the new pads. Use proprietary caliper pliers.

5. Clean: Clean the brake pad recesses in the caliper, using a vacuum brush to remove any dry dust.

   **WARNING:** Inhalation of brake dust can be injurious to health. Never use an airline to blow away dust from around any brake assembly.

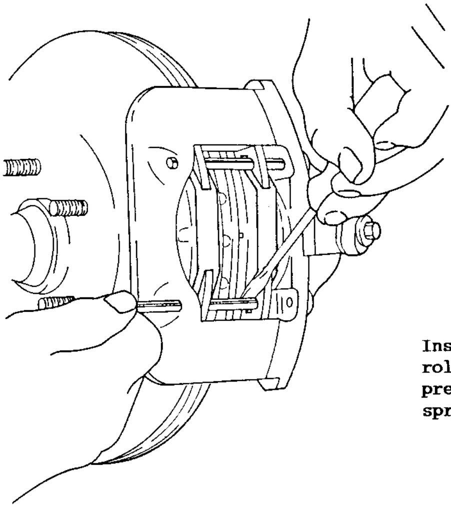
   Inspect the condition of the piston boot, and replace if necessary (see below).

6. Check Discs: Before fitting new brake pads, always check the thickness, surface condition and run-out of the brake discs. See section JE.7.

7. Fit Pads: Ensure that the piston is pushed fully back into its bore before attempting to fit new pads. Fit the inboard pad into position before pulling the caliper outboard and fitting the outboard pad.

8. Fit Pin: Fit one of the two spring pins through the caliper body holes and pad backplates, with the slot in the pin positioned so that it faces the remaining pin. Use only a brass drift to instal the pins, as a steel drift may damage the ends of the pins and make their subsequent removal difficult.

9. Fit Springs & Pin: Fit the remaining pin through the outboard half of the caliper body, before fitting the two pad anti-rattle wire spring clips - fit one end of the spring under the spring pin previously fitted, hook the centre of the spring over the pad backplate, and push the other end of the spring under the second pin as it is inserted. Repeat for the second spring and fully press home the spring pin with the brass drift.
Check that the two springs are fitted centrally on the pad backplates, with each end of the springs projecting beneath the pins an equal amount.



**Inserting second roll pin whilst pressing down spring clip**

10. Fluid Level: Top up the master cylinder reservoir to the full level, and pump the brake pedal several times to restore working pad position. Recheck reservoir level.

## JE.3 - REAR BRAKE PAD REPLACEMENT

Pad thickness may be checked without disturbing the caliper.
Standard pad thickness - 14.5 mm (0.57 in).
Minimum pad thickness - 1 mm (0.04 in).

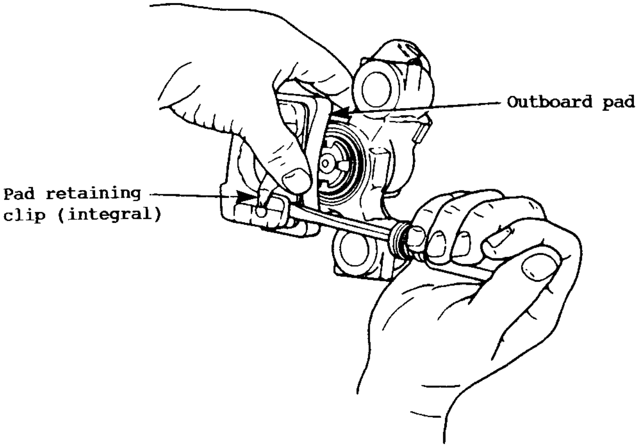
### To Replace Rear Pads

Tools required: Piston Pusher T000T0988

1. Parking Brake Cable: Unhook the parking brake cable from the caliper lever arm, if necessary slackening the cable adjuster on the tunnel top.

2. Withdraw Caliper: Remove the two caliper mounting bolts, and withdraw the caliper from the disc, taking great care not to damage the sliding pin boots. Do not strain the flexible brake hose.

3. Remove Outboard Pad: Use a screwdriver to disengage the buttons on the outboard pad backplate, from the holes in the caliper housing, and withdraw the outboard pad with its integral retaining clip.



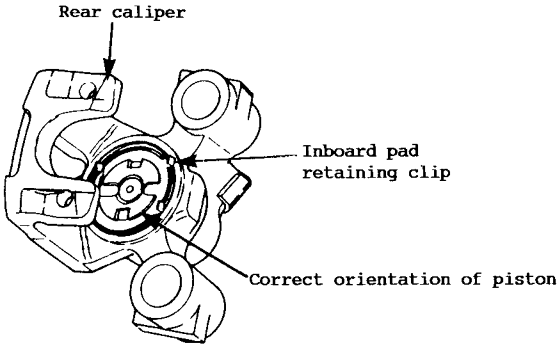
4. Remove Inboard Pad: Prise the inside edge of the inboard pad out from its retaining clip, and then withdraw the pad from the clip and caliper.

5. Remove Check Valve: Use a small screwdriver to prise out the two way check valve from the piston.
If there is any sign of fluid leakage from the piston hole after removal of the check valve, the caliper should be overhauled as detailed in JE.6.
Check the condition of the piston boot, and replace (see JE.6) if necessary.

6. Bottom Piston: Before new pads may be fitted, it is necessary to fully return the piston in its bore. If necessary, syphon fluid from the master cylinder reservoir to make room for the fluid returned from the caliper. Use tool T000T0988 to engage in the slots of the piston, and turn the piston:
- clockwise on LH caliper, or;
- counterclockwise on RH caliper;
to wind the piston back down the parking brake mechanism, whilst pressing the piston down the bore.

7. Fit Check Valve: Lubricate a new check valve with clean brake fluid, and fit into the piston hole.

8. Fit Inboard Pad: Check that the piston is correctly orientated - the axes of the cross shaped slot in the piston should be radial and tangential. Turn the piston if necessary. Check also that the pad retaining clip is fully located in the groove on the end of the piston.



Engage the outside edge of the pad backplate into the retaining clip, before pressing the pad flat against the piston to engage the clips on the inside edge of the backplate. Check that the pad lies flat against the piston, with the buttons on the pad backplate engaged with the slot in the piston.

9. Fit Outboard Pad: Press the pad into position, so that the buttons on the pad backplate engage with the holes in the caliper housing, with the pad retained by the two legs of the clip.

10. Refit Caliper: Carefully examine the sliding pin boots for nicks, cuts or deterioration, and replace if necessary (see JE.6). Position the caliper over the brake disc, taking care not to damage the sliding pin boots, and refit the two caliper retaining bolts. Torque tighten the bolts to 90 - 110 Nm (66 - 80 lbf.ft).

11. Parking Brake Cable: Refit the parking brake cable to the abutment bracket and caliper lever arm, and if necessary, re-adjust cable as detailed in JE.4.

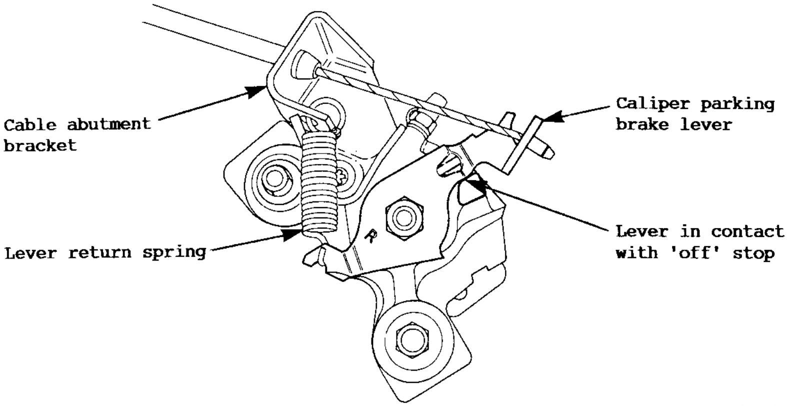
12. Top up the master cylinder reservoir to the full level, and pump the brake pedal, hard, several times to restore working pad position. Recheck reservoir level. Check parking brake operation.

## JE.4 - PARKING BRAKE MECHANISM

It is important, if the self adjusting mechanism is to function correctly, that the caliper levers are fully back against their stop brackets when the parking brake is 'off'.

To Adjust:
1. Ensure that the pads are at their working position, by applying hard pressure to the footbrake pedal several times.

2. At each caliper, check that the parking brake lever is fully against its 'off' stop bracket, and check that when the parking brake is applied and released, the caliper levers return immediately, and are not delayed by excess friction in the cables or linkage. Rectify as necessary.


Cable abutment bracket
Lever return spring
Caliper parking brake lever
Lever in contact with 'off' stop
R

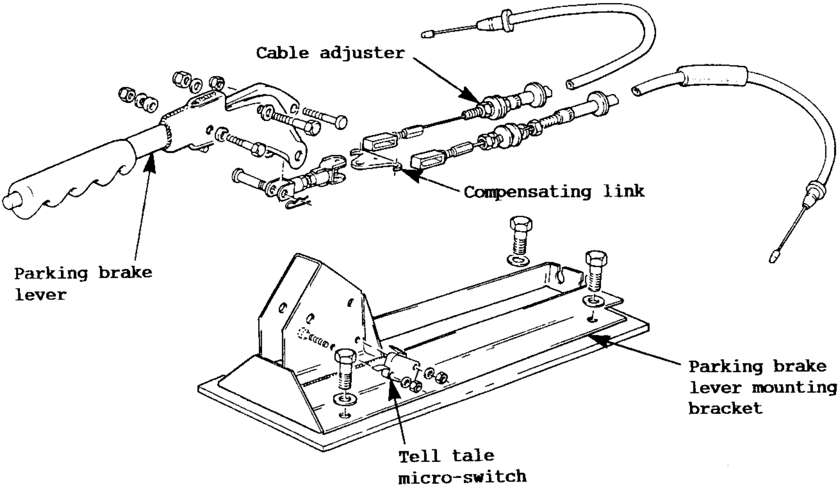
3. Pull out the tunnel top oddments tray to gain access to the parking brake cable adjusters at their forward end abutment. Use the adjusters to remove the slack from each cable, but ensure that the caliper levers are still in contact with their stops.

4. Operate the parking brake several times to allow the automatic adjusters within the caliper to take up any excess clearance, and check that the parking brake lever travels no more than 7 clicks when fully applied.

5. Refit the tunnel top tray.

Cable Replacement:

Remove the tunnel top trim to gain access to the front end of the cables:


Cable adjuster
Compensating link
Parking brake lever
Parking brake lever mounting bracket
Tell tale micro-switch

i) Remove the filler panel from between the rear of the centre tunnel console and the rear wall, by releasing the single retaining screw.
ii) Pull out and disconnect the mirror control switch, to the rear of the gear lever.
iii) Pull out and disconnect the two window switches, each side of the parking brake lever, and release the two console front fixing screws via the switch apertures.
iv) Pull out the oddments tray from the rear of the tunnel top, and release the two console rear fixings via the tray aperture. Pull the console to the rear to disengage the tongues from the main fascia, and then lift the console over the parking brake lever.

The front end of each cable is fitted with an eye which hooks onto the compensating link which is itself connected by a short link to the parking brake lever. Back off the cable adjuster to enable the eye to be unhooked from the compensator, and release the cable adjuster from the abutment bracket. Unhook the cable at the caliper lever, and release from the cable abutment and retaining clips on the rear suspension top link. Withdraw the cable through the body with its grommets.

Reverse the removal procedure to refit a cable, and adjust as detailed above.

Parking Brake Lever:

The parking brake lever incorporates a pawl and ratchet mechanism which is released by a button in the end of the handgrip. If the pawl or ratchet teeth become excessively worn, they should be replaced as a pair.

To remove the parking brake lever, release the clevis securing the tie rod to the compensator lever, remove the clevis pin retaining the ratchet plate, and release the lever pivot bolt. Withdraw the lever assembly from the mounting bracket. The mounting bracket is secured to the chassis centre section by four M8 bolts with weldnuts.

## JE.5 - FRONT CALIPER OVERHAUL

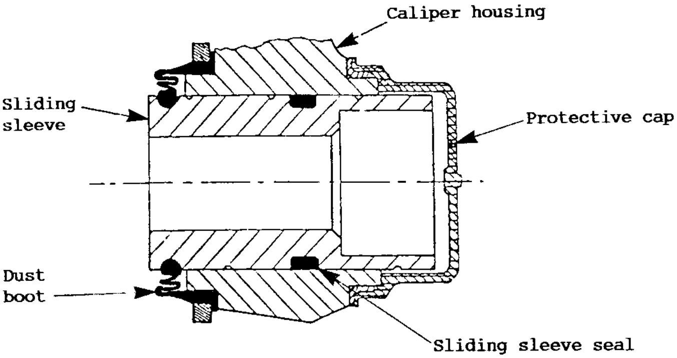
Tools required: Sliding pin boot/cap installer T000T0986

1. Remove Brake Pads: See section JE.2.

2. Hydraulic Hose: Fit a brake hose clamp before releasing the banjo bolt securing the flexible hose to the caliper. Remove the bleeder valve. Seal the hose and caliper openings to prevent fluid loss and dirt ingress.

3. Mounting Bolts: The caliper is mounted via the two sliding sleeves, each of which is secured by a socket head bolt concealed by a protective cap over the end of the sleeve. Prise off the caps, and release the two socket head screws. Withdraw the caliper to a clean bench.
Do NOT disturb the two bolts securing the two halves of the caliper body together.

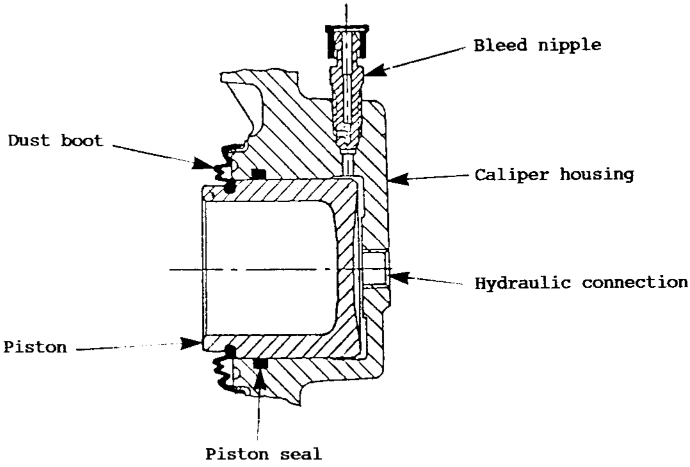
4. Sliding Sleeves: Prise off the boots, and push the two sliding sleeves from the caliper bracket. Carefully examine the rubber boots for cuts, nicks or deterioration and the bolts and sleeves for any signs of corrosion. Replace any faulty parts as necessary.


Caliper housing
Sliding sleeve
Protective cap
Dust boot
Sliding sleeve seal

5. Piston & Dust Boot: Prise the piston dust boot from the caliper housing, and pull off from its groove in the piston. Insert a 15 mm thick piece of hardwood wrapped in shop towel into the caliper gap, and eject the piston from its bore by applying compressed air to the hydraulic inlet connection.

   WARNING: KEEP FINGERS WELL CLEAR during this operation.

6. Piston Seal: Remove the piston seal from the cylinder groove using a plastic tool. Do not use a metal tool, or the cylinder wall or the seal groove may become scratched.


Bleed nipple
Dust boot
Caliper housing
Hydraulic connection
Piston
Piston seal

7. Clean: Clean all parts in denatured alcohol, and dry with unlubricated compressed air (lubricated shop air may damage rubber brake components). Blow out all the passages in the caliper housing and bleeder valve.

8. Inspect: Inspect the following components;
   - caliper bore and seal groove for scoring, nicks, corrosion or visible wear;
   - piston for scoring, nicks, corrosion or damaged chrome plating;
   - caliper bridge for any signs of cracking.

   If any light corrosion cannot be polished out using crocus cloth, or if any other faults are found, the components must be replaced.

9. Piston Seal: Lubricate a new piston seal with clean brake fluid, and fit into the cylinder groove, making sure it is not twisted.

10. Piston and Boot: Fit a new piston boot lubricated with the rubber grease supplied in the repair kit, into the groove on the piston, as shown in the diagram. Lubricate the piston with clean brake fluid, and insert into the cylinder, pushing to the bottom of the bore.
    Seat the boot in the caliper housing counterbore using a suitable press tool. Let any trapped air escape from behind the boot, by easing the boot away from the piston groove using a plastic tool.

11. Sliding Sleeves: Apply a thin coat of the special grease provided in the repair kit, to the surface of the sleeves. Fit the seal rings into their grooves in the centre of the sleeves, ensuring that the seals are not twisted.
    Slide the sleeves into their caliper bores from the disc side, leaving the boot grooves accessible. Apply some of the grease to the lips of each dust boot, and fit into the sleeve groove. Press the boot collar into position on the housing using a suitable tool.

12. Fit Caliper: Fit the caliper over the brake disc. **CAUTION** - Take great care not to damage the sliding pin boots when fitting the caliper. Fit the two caliper mounting bolts using a thread locking compound (e.g. Loctite). Torque tighten to 85 - 110 Nm (63 - 81 lbf.ft). Fit the protective caps to the ends of the sliding pins using special tool T000T0986.

13. Flexible Hose: Fit the flexible hose to the caliper using new or annealed copper washers, and torque tighten to 40 Nm (30 lbf.ft). Fit the bleed nipple and torque to 9 - 16 Nm (80 - 140 lbf.in).

14. Brake Pads & Bleeding: Refit the brake pads as detailed in JE.2. Remove the brake hose clamp, and bleed the brake system to expel all air.

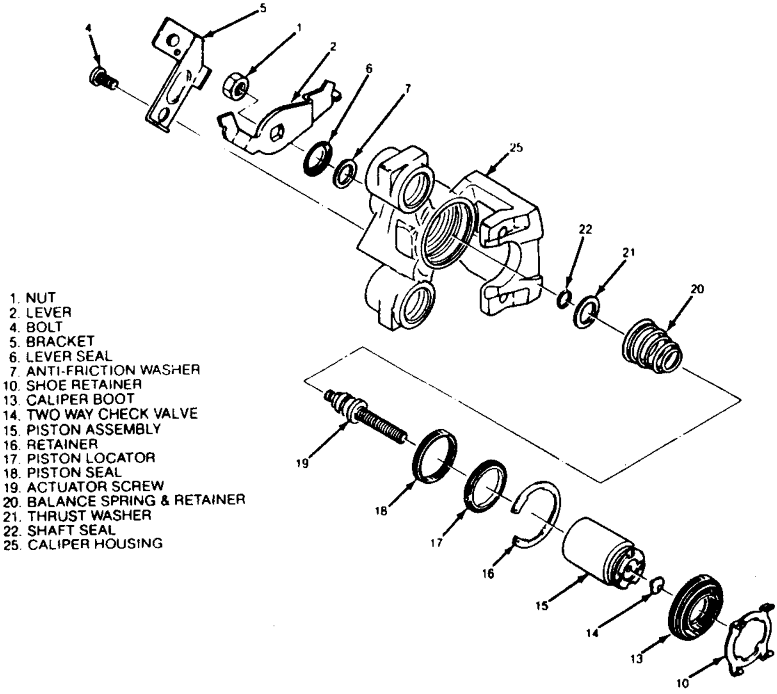
## JE.6 - REAR CALIPER OVERHAUL

Tools required: Piston Locator Installer T000T0987
Piston Pusher T000T0988

1. Hydraulic Hose: Fit a brake hose clamp before releasing the banjo bolt securing the flexible hose to the caliper. Remove the bleeder valve. Seal the hose and caliper openings to prevent fluid loss and dirt ingress.

2. Caliper & Pads: Remove the caliper and brake pads (see JE.3).

3. Sliding Sleeves: Pull off the boots, and push the two sliding sleeves from the caliper bracket. Carefully examine the rubber boots for cuts, nicks or deterioration and the bolts and sleeves for any signs of corrosion. Replace any faulty parts as necessary.



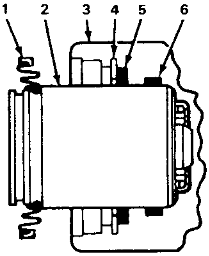
1. NUT
2. LEVER
4. BOLT
5. BRACKET
6. LEVER SEAL
7. ANTI-FRICTION WASHER
10. SHOE RETAINER
13. CALIPER BOOT
14. TWO WAY CHECK VALVE
15. PISTON ASSEMBLY
16. RETAINER
17. PISTON LOCATOR
18. PISTON SEAL
19. ACTUATOR SCREW
20. BALANCE SPRING & RETAINER
21. THRUST WASHER
22. SHAFT SEAL
25. CALIPER HOUSING

4. Remove Piston: Remove the securing nut and pull off the parking brake lever arm, lever seal and anti-friction washer. Use a spanner to turn the actuator screw in the brake apply direction, and so push the piston out of the cylinder. Use clean rags or shop towels to protect the piston during this operation, and remove the pad retaining clip from the piston if this has not already been done.

5. Actuator Screw: Remove the balance spring from inside the cylinder, and push out the actuator screw. Remove the screw thrust washer, and the shaft seal.

6. Piston Boot: Prise out the piston boot taking care not to scratch the cylinder bore.

7. Piston Locator & Seal: Remove the circlip, and pull out the piston locator. Use a plastic tool to remove the piston seal from its groove in the cylinder, in order to prevent scratching the cylinder wall or groove.



1. **Dust boot**
2. **Piston**
3. **Caliper housing**
4. **Circlip**
5. **Piston locator**
6. **Piston seal**

8. Inspect: Carefully inspect the cylinder wall and groove, and piston surface for any signs of;
   - scoring
   - nicks
   - corrosion
   - visible wear or damage to chrome plating

   If any light corrosion cannot be polished out using crocus cloth, or if any other faults are found, the components must be replaced.

9. Clean: Clean all parts in clean, denatured alcohol, and dry with unlubricated compressed air (lubricated shop air may damage rubber brake components). Blow out all the passages in the caliper housing and bleeder valve.

10. Abutment Bracket: If necessary, remove the parking brake cable abutment bracket. When re-fitting, torque tighten the single fixing screw to 33 - 52 Nm (24 - 38 lbf.ft).

11. Piston Seal: Lubricate a new piston seal with clean brake fluid, and carefully fit into its groove in the cylinder wall. Ensure the seal is not twisted.

12. Piston Locator: Lubricate a new piston locator, and fit onto the piston using installer tool T000T0987

13. Actuator Screw: Fit the thrust washer onto the actuator screw, with the copper side of the washer towards the piston and the grayish side towards the caliper housing. Lubricate the shaft seal and fit into the actuator screw groove. Fit the screw fully into the piston.

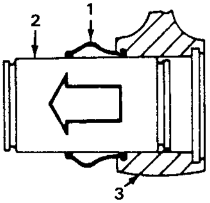
14. Piston: Lubricate the cylinder bore. Fit the balance spring onto the end of the piston, and insert the piston with actuator screw into the cylinder. Push the piston into the bore until the locator is past the circlip groove. Fit the retainer circlip using circlip pliers.
    Fit the lubricated piston boot into its groove in the end of the piston, before pressing the piston to the bottom of the bore.

15. Lever Arm: Fit the lubricated anti-friction washer over the end of the actuator screw, followed by the lubricated lever seal with the sealing bead towards the caliper body. Fit the lever arm in the correct orientation (between the cable abutment and 'off' stop) and retain with the nut. Hold the lever whilst torque tightening the nut to 40 - 55 Nm (30 - 40 lbf.ft)
    Fit the lever return spring.

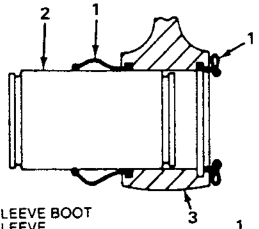
16. Piston Boot: Seat the piston boot in its counterbore in the caliper using a suitable tool.

17. Sliding Sleeves: Use silicon grease to lubricate the sliding surfaces of the sliding sleeves and corresponding surfaces in the caliper bracket. Lubricate both lips of the four sleeve boots. Instal each sliding pin in the following manner; **CAUTION:** Use no other grease than that specified.

- fit one boot into its groove in the caliper and slide the pin in from the opposite side of the caliper hole, pushing through the boot inside diameter.

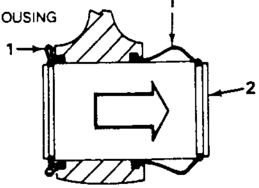


- fit the second boot into the caliper groove.



1 SLEEVE BOOT
2 SLEEVE
3 CALIPER HOUSING

- Push the pin back through the second boot and locate the inside diameter of both boots in their grooves on the sliding pin.



18. Fit Check Valve: Lubricate a new check valve with clean brake fluid, and fit into the piston hole.

19. Fit Inboard Pad: Check that the piston is correctly orientated - the axes of the cross shaped slot in the piston should be radial and tangential. Turn the piston if necessary. Check also that the pad retaining clip is fully located in the groove on the end of the piston.
Engage the outside edge of the pad backplate into the retaining clip, before pressing the pad flat against the piston to engage the clips on the inside edge of the backplate. Check that the pad lies flat against the piston, with the buttons on the pad backplate engaged with the slot in the piston.

20. Fit Outboard Pad: Press the pad into position, so that the buttons on the pad backplate engage with the holes in the caliper housing, with the pad retained by the two legs of the clip.

21. Refit Caliper: Position the caliper over the brake disc, taking care not to damage the sliding pin boots, and refit the two caliper retaining bolts. Torque tighten the bolts to 90 - 110 Nm (66 - 80 lbf.ft).

22. Parking Brake Cable: Re-connect the parking brake cable to the abutment bracket and lever arm.

23. Flexible Hose: Fit the flexible hose to the caliper using new or annealed copper washers, and torque tighten to 40 Nm (30 lbf.ft). Fit the bleed nipple and torque to 9 - 16 Nm (80 - 140 lbf.in).

24. Bleeding: Top up the master cylinder reservoir. Operate the parking brake several times to attain the correct brake pad position (until parking brake lever feels 'firm'). Remove the brake hose clamp before bleeding the system to expel all air.
    Test operation of footbrake and parking brake.

## JE.7 - BRAKE DISCS

Check the braking surface on both sides of the brake discs for scoring or corrosion. Replace if in doubt.

Measure the discs thickness and run-out:

| | Front | Rear |
|---|---|---|
| Thickness, nominal | 24.0 mm (0.95 in.) | 12.7 mm (0.50 in.) |
| Minimum regrind thickness | 23.0 mm (0.91 in.) | 11.5 mm (0.45 in.) |
| Minimum thickness (wear limit) | 22.0 mm (0.87 in.) | 10.9 mm (0.43 in.) |
| Maximum run-out, installed | 0.10 mm (0.004 in) | 0.10 mm (0.004 in) |
| Maximum run-out, removed | 0.03 mm (0.001 in) | 0.03 mm (0.001 in) |

NOTE: Ensure the rear wheel bearings are correctly adjusted before measuring rear disc run-out.

If the run-out is excessive, replace the disc.

## JE.8 - BRAKE SERVO UNIT

The brake vacuum servo is a non-servicable sealed unit which if found to be faulty, must be replaced as a unit, complete with the vacuum non-return valve fitted into the vacuum line between servo unit and intake plenum chamber.

As a quick check of servo operation proceed as follows: With engine stopped, press the brake pedal several times to exhaust the servo unit of vacuum. Keeping the pedal pressed (which should be 'hard' and 'high'), start the engine; the pedal should drop slightly as the servo vacuum builds up, and extra force is produced. If the pedal does not drop, it is most likely that there is a fault in the vacuum supply line. Check the vacuum hose, connections and non-return valve. If the vacuum supply is not defective, the servo unit should be replaced.

It is essential that the servo piston is allowed to return fully when the brakes are released, and is not pre-loaded by mal-adjustment of the input pushrod. Check that there is a small amount of free play at the pushrod when the brake pedal is released.

### To Remove Servo Unit

The servo unit, if diagnosed as being faulty, must be withdrawn together with the pedal box, towards the inside of the car.

1. Centre Console: Remove the centre console and instrument panel (see section M).

2. Fascia: Remove the fascia panel (see section V).

3. Steering Column: Remove the steering column (see section H).

4. Throttle Cable: Pull off the spring clip, and unhook the cable from the throttle pedal.

5. Clutch Cable: Pull back the clutch release lever on the transmission, and unhook the cable from the clutch pedal.

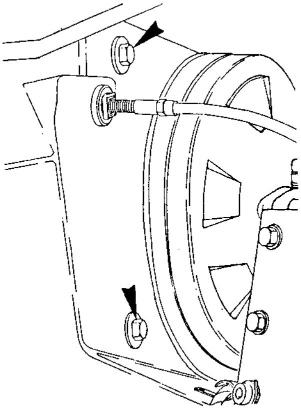
6. Wiring Harness: Disconnect the main earth point from the rear face of the pedal box. Release the cable ties securing the main harness in the carrier duct across the back of the pedal box, and push the harness out of the duct. Disconnect the brake light switch.

7. Master Cylinder: Release the two nuts securing the master cylinder to the servo. Leave the hydraulic system undisturbed.

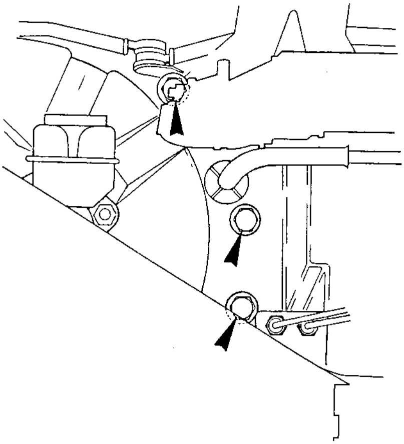
8. Vacuum Hose: Disconnect the brake servo hose.

9. Pedal Box: Release the five bolts from the engine side of the front bulkhead securing the pedal box, and withdraw the pedal box complete with servo into the driver's footwell.

**Servo outboard fixings viewed from wheelarch**



**Servo inboard fixings viewed from engine bay**

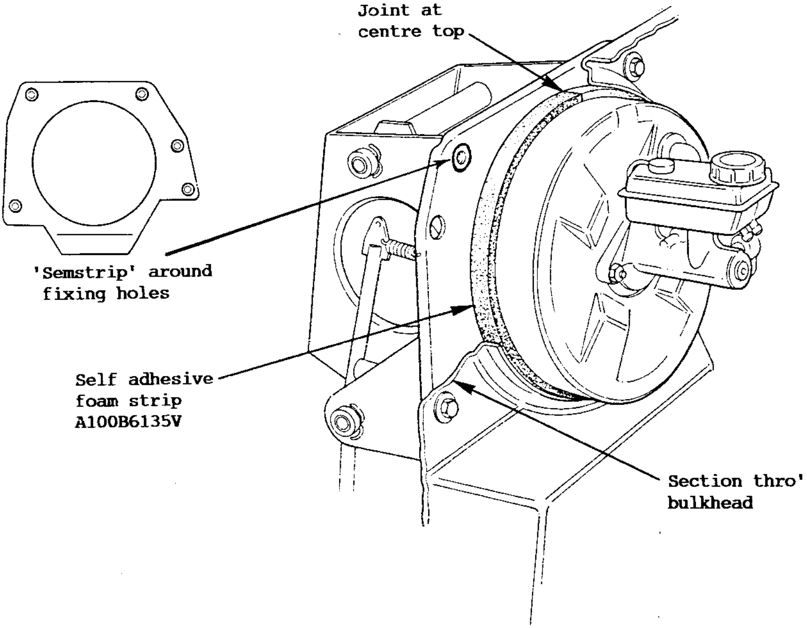


10. Servo: Disconnect the servo pushrod from the pedal, release the four nuts securing the servo to the pedal box, and withdraw the servo unit.

To Replace Servo Unit

Reverse the removal procedure to replace the servo, noting the following points:

- Torque tighten servo to pedal box nuts to 16 - 20 Nm (12 - 15 lbf.ft).
- Adjust servo input pushrod for slight free play when brake is off.
- Apply a 700mm length of self adhesive foam strip (A100B6135V) around the body of the servo unit, aligning with the rear edge. Position the joint at the centre top.
- Apply a ring of 'Semstrip' A100J6021 on the pedal box around each of the pedal box fixing holes, to seal the pedal box to the bulkhead.
- Torque tighten pedal box fixing bolts to 22 Nm (16 lbf.ft).

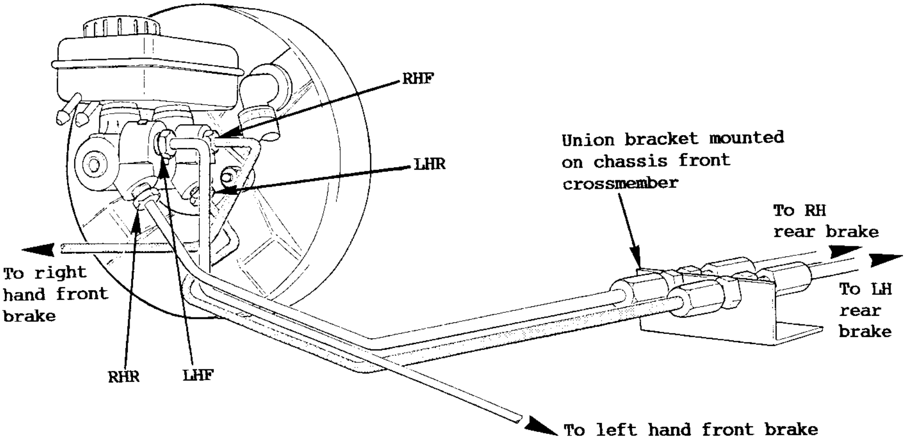

Joint at centre top
'Semstrip' around fixing holes
Self adhesive foam strip A100B6135V
Section thro' bulkhead

JE.9 - MASTER CYLINDER

The brake master cylinder is a non-servicable sealed assembly, which must be replaced as a complete unit if found to be faulty.

To Replace Master Cylinder
- Before removing the master cylinder, syphon out as much brake fluid as possible from the reservoir to reduce the amount of spillage.
- Disconnect the low fluid tell tale harness from the reservoir cap.
- Disconnect the three brake pipes from the master cylinder ports, and plug the pipes and ports to reduce spillage and prevent dirt ingress.
- Remove the two nuts securing the master cylinder to the brake servo, and withdraw the master cylinder.

Refit the master cylinder in the reverse order to that above, refill with brake fluid, and bleed the complete system in the usual manner.


RHF
LHR
Union bracket mounted on chassis front crossmember
To RH rear brake
To LH rear brake
To right hand front brake
RHR
LHF
To left hand front brake

- Torque tighten master cylinder to servo fixings to 15 - 18 Nm (11 - 13 lbf.ft)
- Torque tighten brake pipes to master cylinder to 10 - 15 Nm (7.5 - 11 lbf.ft)

## JE.10 - PRESSURE LIMITING & PROPORTIONING VALVES

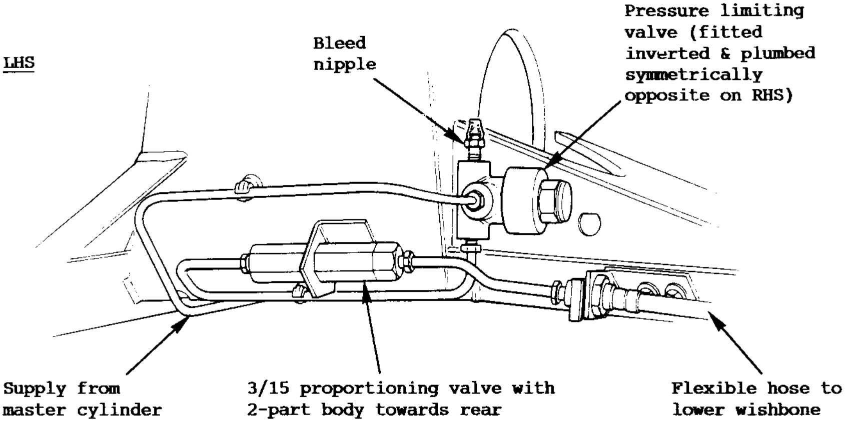
A pressure proportioning valve is fitted into each of the rear brake circuits in order to control the rear brake pressure under severe braking, and reduce any tendency for the rear wheels to lock before the front. Early cars used, in addition to and connected in series with each proportioning valve, either a pressure limiting valve, or a second proportioning valve in order to obtain the desired pressure rise characteristics. Thus the three variations to be found are:

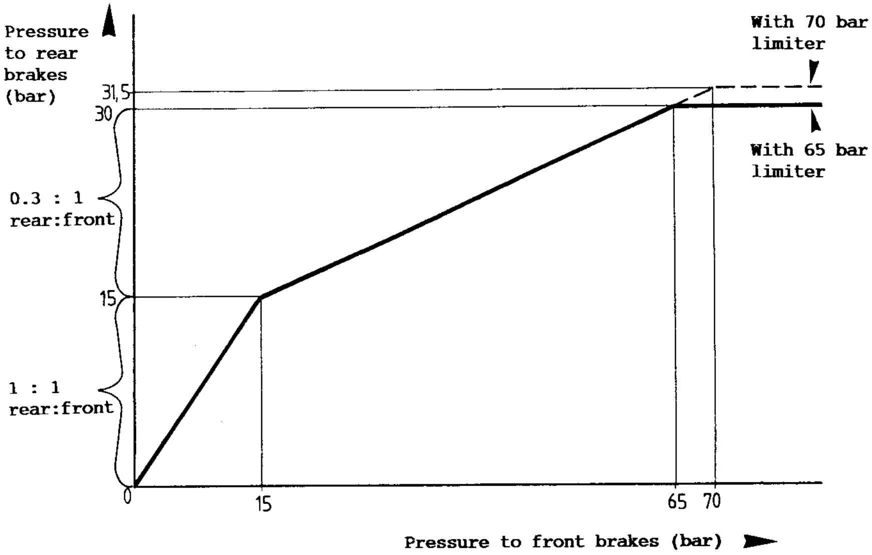
### i) Pressure Limiting Valve (70 or 65 bar) + Proportioning Valve (3/15)

The limiting valves are fitted upstream of the proportioning valves, and are set at either 70 bar, or on later cars, 65 bar. This figure is stamped on the valve end plate. At brake line pressures below the valve calibration, the valve is open, and allows unrestricted flow of brake fluid from the master cylinder to the proportioning valve. When the output pressure from the master cylinder (same front and rear) reaches the limiting valve calibration pressure, the valve closes, and allows no further increase in pressure to the rear brake circuit. The valve opens again when supply pressure drops below 70 or 65 bar.

The proportioning valves are designated 3/15, which indicates;

- up to the 'break point' of 15 bar, the pressure in each rear brake circuit is the same as that in the front circuit.
- as the front circuit pressure increases from 15 bar to 65 or 70 bar (see above), the corresponding increase in rear circuit pressure is in the ratio of 0.3:1.

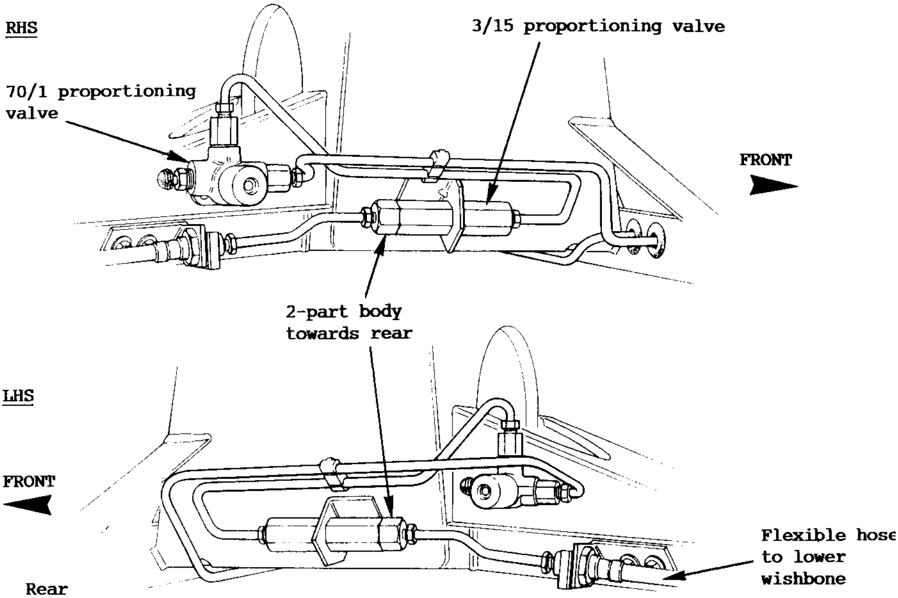

LHS
Bleed nipple
Pressure limiting valve (fitted inverted & plumbed symmetrically opposite on RHS)
Supply from master cylinder
3/15 proportioning valve with 2-part body towards rear
Flexible hose to lower wishbone

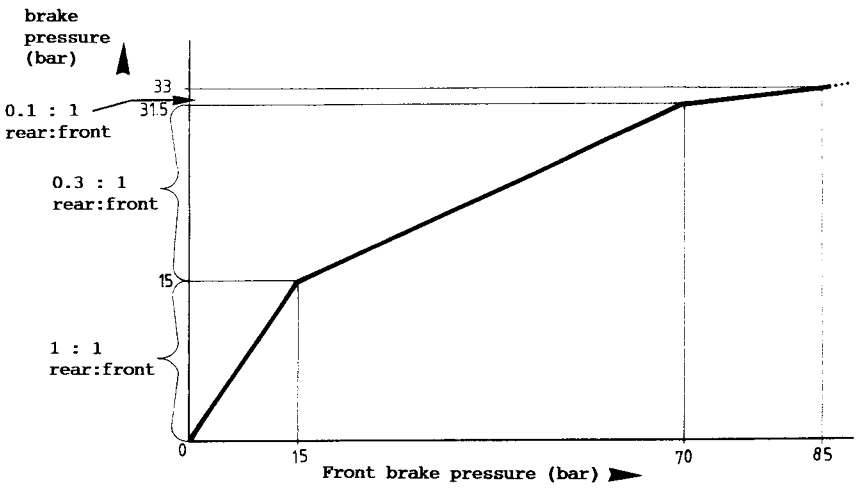


If any problems are experienced with the limiting valves or 3/15 proportioning valves, it is recommended to discard all four valves and fit two 2/15 proportioning valves as described in (iii).

ii) Proportioning Valve (70/1) + Proportioning Valve (3/15)

The 3/15 proportioning valves are the same as those in (i) above, and operate in the same way. The 70/1 valves are fitted upstream of the 3/15 valves, and take effect only when input pressure exceeds 70 bar. Thereafter, the increase in output pressure is 0.1 of the increase in input pressure.

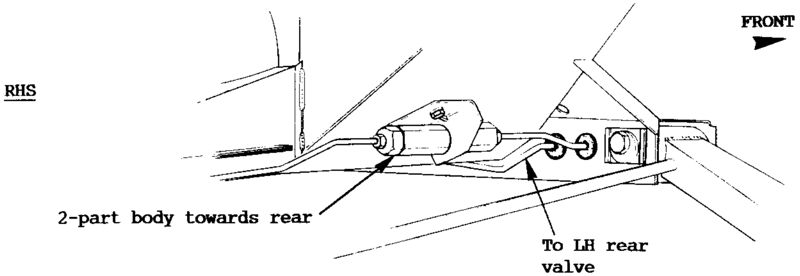

RHS
3/15 proportioning valve
70/1 proportioning valve
FRONT
2-part body towards rear
LHS
FRONT
Flexible hose to lower wishbone

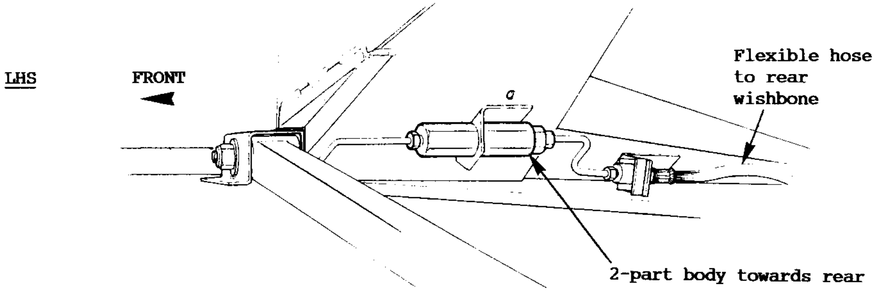


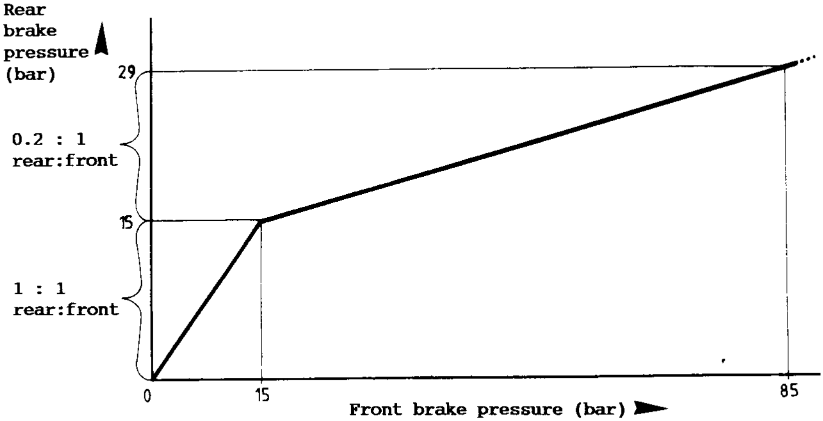
If any problems are experienced with the 70/1 or 3/15 proportioning valves, it is recommended to discard all four valves and fit two 2/15 proportioning valves as described in (iii).

iii) Pressure Proportioning Valve (2/15)

These cars use a single proportioning valve (2/15) in each rear circuit, and this is the preferred arrangement to be adopted should any problems be encountered with either of the previous two systems. These valves have no effect until input pressure exceeds 15 bar, after which the increase in output pressure is 0.2 of the increase in input pressure.


RHS
FRONT
2-part body towards rear
To LH rear valve


LHS
FRONT
Flexible hose to rear wishbone
2-part body towards rear



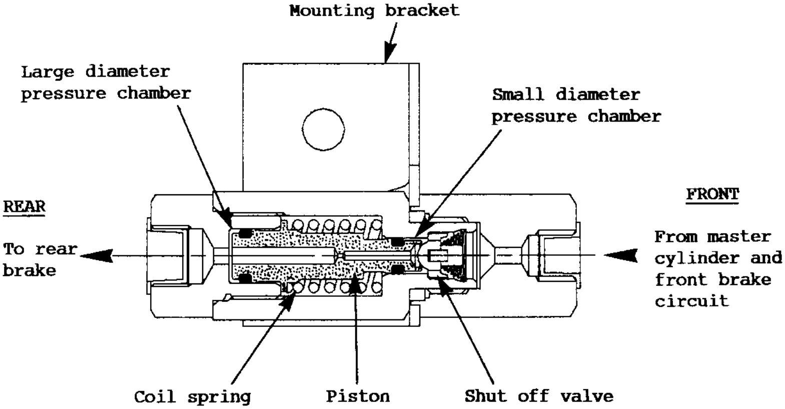
If fitting the 2/15 valves in place of either of the systems described in (i) or (ii), the following parts will be required:

| | | |
|---|---|---|
| Proportioning Valve 2/15 | D100J6025F | 2 off |
| Brake Pipe, prop valve input, RH | A100J0082F | 1 off |
| Brake Pipe, prop valve input, LH | A100J0083F | 1 off |

Operation of Proportioning Valve

The following description applies to a 2/15 proportioning valve, but the principle is similar for the 3/15 valve.

Each unit consists of an anodised aluminium body containing a spring loaded piston, through the centre of which the brake fluid flows from the front to the rear circuit. A small diameter pressure chamber at the front end of the piston, is connected to the front brake line, and includes a shut off valve. A larger diameter pressure chamber at the rear end of the piston is connected to the rear brake circuit.


Mounting bracket
Large diameter pressure chamber
Small diameter pressure chamber
REAR
FRONT
To rear brake
From master cylinder and front brake circuit
Coil spring
Piston
Shut off valve

At brake line pressures below 15 bar, the proportioning valve is open, and fluid flows through the unit freely to provide equal front and rear brake line pressures.

The piston is spring loaded towards the outlet end, but the hydraulic force on the piston from the large diameter outlet (rear) end, is greater than that from the small diameter inlet (front) end. At a pressure of 15 bar, the difference in hydraulic force is equal to the force on the piston from the spring, with the result that the piston starts to move towards the inlet end of the unit, closing the valve as it does so.

As front brake pressure is increased beyond 15 bar, the valve will open only sufficiently to allow the pressure in the outlet side to increase by 0.2 of this amount, since this is all that is required for the larger diameter outlet end pressure chamber to close the valve and maintain the pressure balance.

The reverse logic applies as the brake pressure is reduced, with the valve opening to allow the rear pressure to fall at a rate of 0.2 of the front pressure reduction until the break point at 15 bar, when the piston spring overcomes the pressure differential, and the valve stays open, equalising front and rear pressures.

Valve Servicing

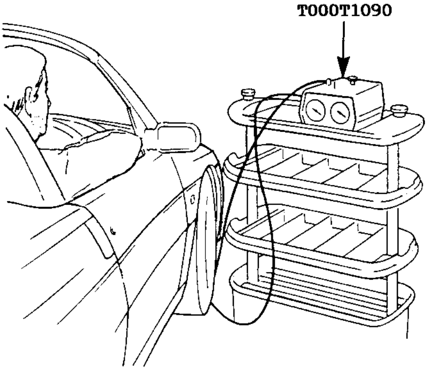
**NO SERVICING OF THE PRESSURE LIMITING OR PROPORTIONING VALVES IS PERMITTED.** Do not attempt to disassemble or repair a limiting or proportioning valve. The 3/15 and 2/15 proportioning valves incorporate a mounting bracket which should not be disturbed. If a proportioning valve is found to leak brake fluid, or if the performance test indicates a faulty unit, **BOTH PROPORTIONING VALVES SHOULD BE RENEWED AS A PAIR.** If an early type 4-valve system is fitted, and found to be faulty, it is recommended that all four valves be discarded and a pair of the later type 2/15 proportioning valves are fitted as described above.

Both right and left hand 2/15 proportioning valve assemblies are identical, and due to the offset fixing bracket hole, cannot be fitted and connected up the wrong way round without considerable modification to the brake pipes. The two part body of the valve should be to the rear.

Torque tighten brake pipe connections to 15 Nm (11 lbf.ft).

Performance Test

Tools Required: Test gauge T000T1090



1. Referring to the test gauge manufacturer's instructions, remove the bleed nipple from one of the rear calipers, and connect the test gauge adaptor to the caliper.

2. Connect the other test gauge pipe to the diagonally opposite front brake caliper bleed nipple port.

3. After bleeding the system, operate the brakes to achieve the front brake line pressures in the following table, and note the corresponding rear brake line pressure. **Do not exceed a front brake pressure of 100 bar.**

| Front Pressure (bar) | Rear Pressure (bar) | | | |
|---|---|---|---|---|
| | 70 bar limiter + 3/15 proport. | 65 bar limiter + 3/15 proport. | 70/1 proport. + 3/15 proport. | 2/15 proport. |
| 5 | 5 | 5 | 5 | 5 |
| 30 | 17.8 - 21.2 | 17.8 - 21.2 | 17.8 - 21.2 | 16.4 - 19.6 |
| 85 | 28 - 35 | 26.7 - 33.3 | 29.4 - 36.6 | 26.5 - 31.5 |

4. If the rear pressure is out of tolerance at any of the test points, comparison of the pressure rise characteristic with the graph shape for the system fitted (see above), should indicate the probable faulty component.

5. Repeat the test on the opposite circuit.

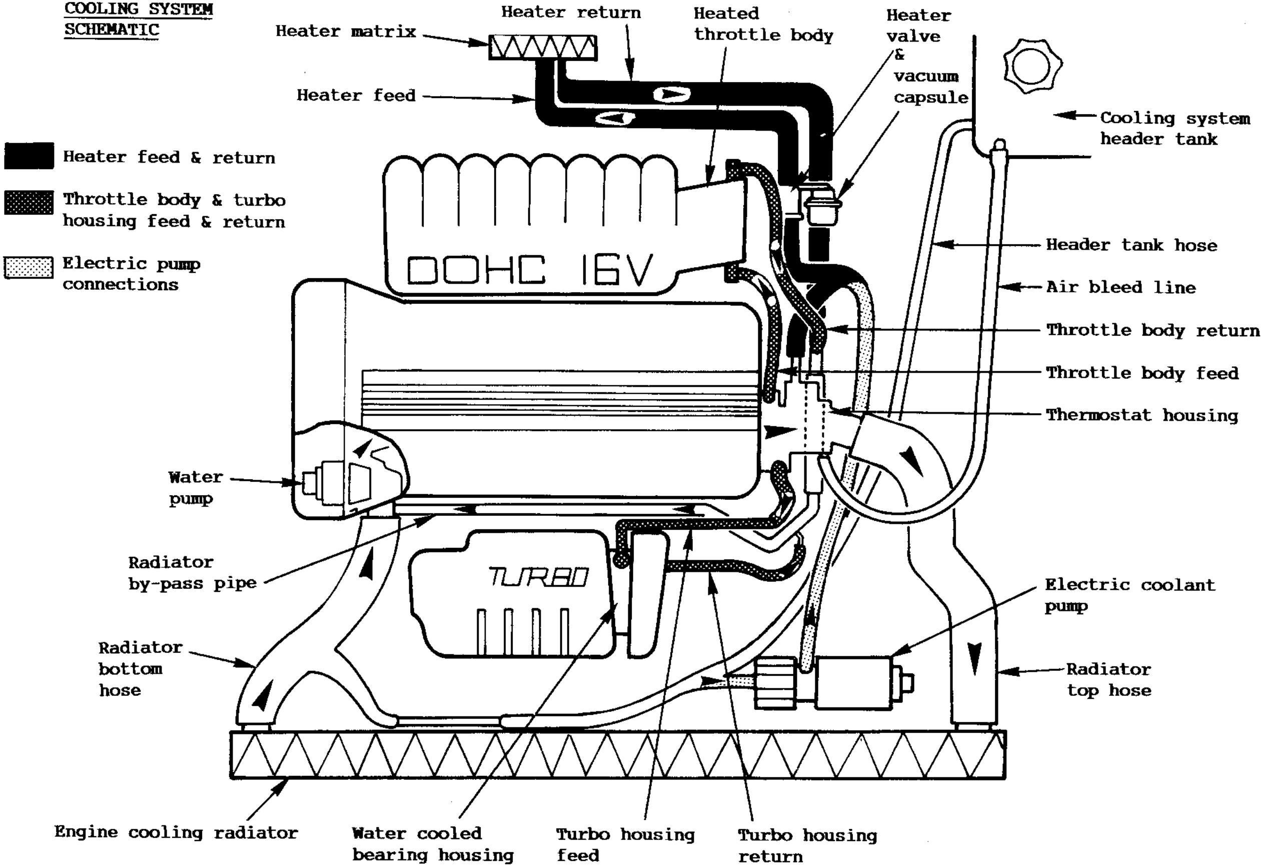
6. Remove test gauge, refit bleed nipples and bleed brakes.

# COOLING SYSTEM

## SECTION KD - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | KD.1 | 3 |
| Maintenance | KD.2 | 5 |
| Drain/Refill Procedure | KD.3 | 6 |
| Radiator Fans & Control | KD.4 | 7 |
| Engine Cooling Radiator | KD.5 | 8 |
| Chargecooler Radiator | KD.6 | 10 |
| Oil Cooler Radiator | KD.7 | 12 |

COOLING SYSTEM
SCHEMATIC


Heater feed & return
Throttle body & turbo housing feed & return
Electric pump connections
Heater matrix
Heater return
Heater feed
Heated throttle body
Heater valve & vacuum capsule
Cooling system header tank
Header tank hose
Air bleed line
Throttle body return
Throttle body feed
Thermostat housing
DOHC 16V
TURBO
Water pump
Radiator by-pass pipe
Radiator bottom hose
Electric coolant pump
Radiator top hose
Engine cooling radiator
Water cooled bearing housing
Turbo housing feed
Turbo housing return

## KD.1 - GENERAL DESCRIPTION

### Engine Cooling System

A centrifugal water pump is mounted on the front face of the cylinder block, and is driven by the toothed camshaft drive belt. Coolant is pumped by the impeller into the front of the block, around the cylinders, up into the cylinder head, and finally out of the back of the head (left hand end of engine), into the thermostat housing. When the thermostat is closed, water flow by-passes the radiator via a by-pass pipe which runs along the front side of the engine to an inlet spout at the left hand front of the block. In order for water on the engine side of the closed thermostat to reach the by-pass pipe, it must flow via one of three routes;

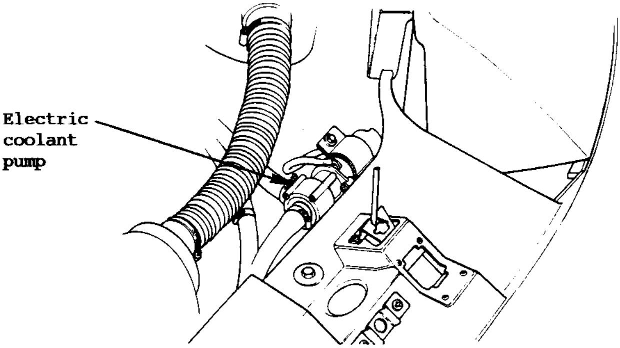
- the heater matrix (if the water valve is open)
- the primary throttle body water jacket
- the turbocharger water jacket

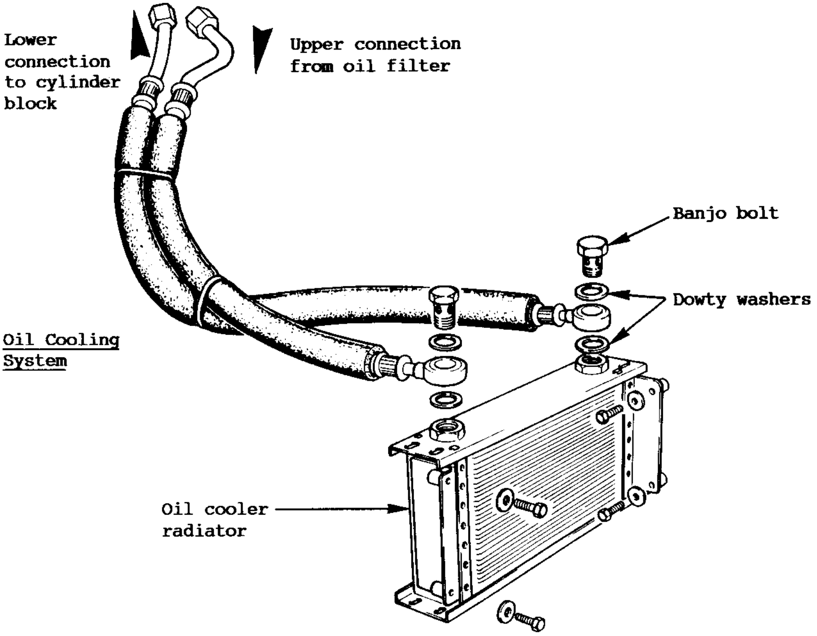
When the thermostat opens, a lesser volume of coolant will flow through these circuits, with the main flow passing through the thermostat into the radiator inlet hose, radiator, outlet hose, and finally back into the water pump via the inlet spout at the left hand front of the block.

A header tank is fitted at the left hand rear of the engine bay, and is connected into the radiator bottom hose, with an air bleed hose connecting the top of the tank with the top of the thermostat housing outlet spout. The tank is fitted with a 120 kPa (17.5 lb/in²) pressure cap to raise the boiling point of the coolant to 131°C.

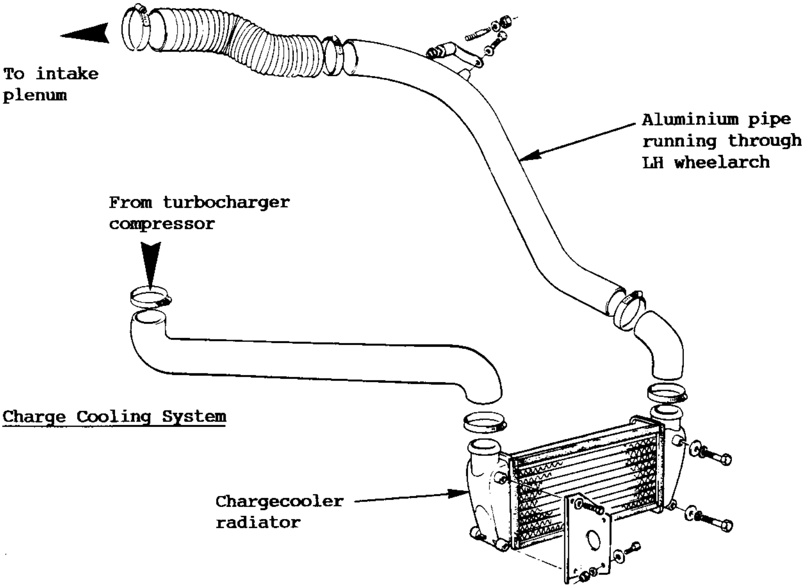
The radiator comprises an aluminium core sandwiched between plastic end tanks, and is flexibly mounted in a support frame by two spigots at the top, and two at the bottom. Two electric cooling fans are mounted on the rear of the radiator, and are controlled by a thermal switch in the thermostat housing outlet spout. The sensor for the water temperature gauge is fitted into the thermostat housing.

In extreme conditions of heat soak, in order to control water temperature after switching off the engine, an electric pump is used to maintain coolant circulation until the temperature drops to a safe level. The centrifugal pump is mounted at the front of the engine bay, and is connected between the radiator bottom hose, and the heater feed hose between the thermostat housing and the water valve. The pump is controlled by the radiator fans thermal switch, and operates only when the ignition is switched **OFF**. With ignition off and thermal switch closed (above 110°C), the pump will run until coolant temperature falls sufficiently for the thermal switch to open (approx 103°C). The electric pump operates to pump cool water from the bottom hose into the cylinder head via the thermostat housing; i.e. in the reverse direction to normal coolant flow.




Lower connection to cylinder block
Upper connection from oil filter
Banjo bolt
Dowty washers
Oil cooler radiator

Oil Cooling System


To intake plenum
Aluminium pipe running through LH wheelarch
From turbocharger compressor
Chargecooler radiator

Charge Cooling System

Oil Cooling System

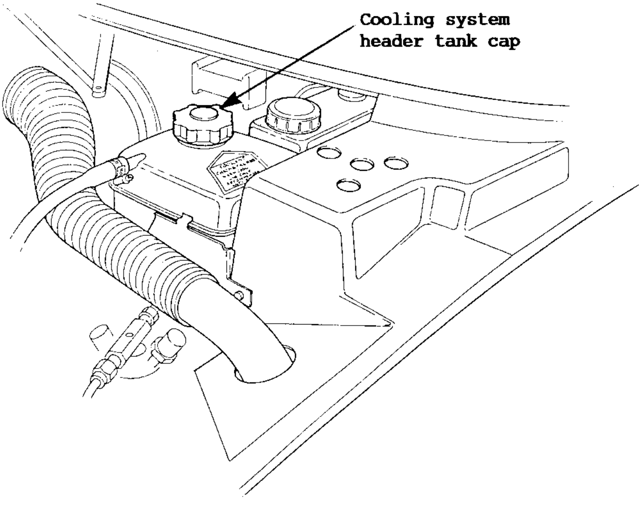
A sandwich plate fitted between the oil filter canister (on the rear side of the cylinder block) and the block, diverts the pressurised oil supply from the oil filter input, via a steel pipe and high pressure hose, to an oil cooler radiator mounted in a separate duct to the right of the engine cooling radiator. Oil returns from the radiator via a hose and steel pipe to the sandwich plate, and then flows through the oil filter and into the engine.

Charge Air Cooling System

Turbocharged models use an air/air heat exchanger (chargecooler) to reduce the temperature and increase the density of air leaving the turbocharger compressor, before it enters the intake plenum chamber. The chargecooler is constructed of aluminium, and is located in a separate duct to the left of the engine cooling radiator. It is connected by moulded hose to the turbocharger compressor outlet, and uses an aluminium pipe routed through the left hand wheelarch to connect with the intake plenum hose.

## KD.2 - MAINTENANCE

Under normal operating conditions, the engine cooling system, being a closed circuit, should not require any topping up between services. As a precaution however, every week, the level of coolant in the engine cooling header tank should be checked. The transluscent header tank is marked with a cold level indicator. The level of coolant will rise as the engine warms up and the coolant expands, and will fall again as it cools down.



**WARNING:** Do NOT remove the cap from the engine cooling header tank when the engine is warm, as serious scalding could result from boiling water and/or steam.

When fully cold, the level of coolant should be up to the 'cold' mark on the header tank. If overfilled, the excess coolant will be ejected when the engine is warm, and if the level is allowed to fall too low, overheating may result. If necessary, top up the system using an approved coolant mixture (see below) to maintain full protection from freezing damage and corrosion.

Anti-Freeze/Corrosion Inhibitor

It is important that the coolant contains an anti-freeze with corrosion inhibitor to protect the engine and heat exchangers from both frost damage, and corrosion of the metallic elements. Use of a good quality mono-ethylene glycol anti-freeze, protects against these dangers as well as improving the cooling efficiency of the system. When new, the system is filled with a 40% concentration of 'Shellsafe Plus' (known as Shell Antifreeze '401' in some overseas markets), which is suitable for all but the very coldest climates, which may use concentrations up to 60% strength. In warm climates it is recommended that the concentration is not allowed to fall below 25%, in order to maintain full corrosion protection.

The simplest means of checking the strength of the Shellsafe Plus/water mix is by checking the density using a hydrometer. The following table provides a general guide:

| | **Density @** | |
|---|---|---|
| **Concentration** | **20°C** | **60°C** |
| 25% | 1.039 | 1.020 |
| 33% | 1.057 | 1.034 |
| 50% | 1.080 | 1.057 |

A satisfactory density reading reflects the effective level of mono-ethylene glycol, and not the level of corrosion inhibitors present, whose effectiveness diminishes over a period of time. The coolant should therefore be renewed every 12 months to ensure optimum protection.

Extremely hard water (hardness exceeding 250 parts per million) should not be used in the cooling system. In such areas, distilled, de-ironised or filtered rain water should be used.

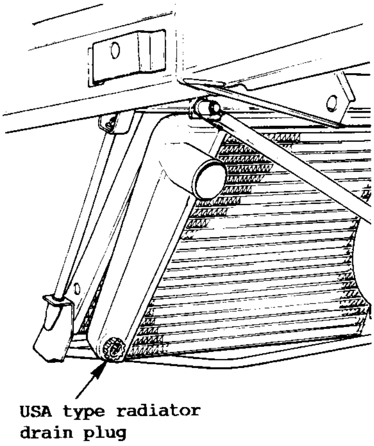
Radiator Fin Cleaning

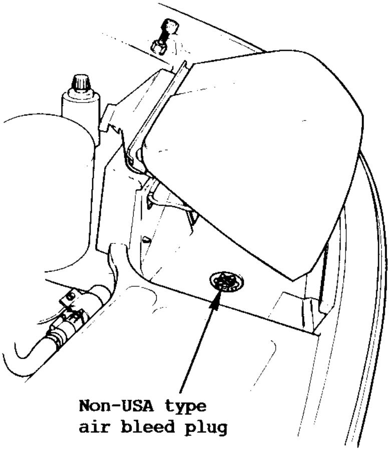
At service intervals, the matrices of all the radiators should be checked for clogging by insects, leaves and other debris. The close finned oil cooler is especially vulnerable. If necessary, use a water jet from behind to clean the fins, and take great care not to damage the fragile tubes with any other tool. At the same time, check the security of all cooling system joints, and the condition of all flexible hoses.

## KD.3 - DRAIN/REFILL PROCEDURE

To drain the engine cooling system, set the heater temperature control to 'hot', remove the header tank cap, and either remove the drain plug from the bottom left hand corner of the radiator (USA models) or disconnect the radiator bottom hose.

To refill the system, replace the drain plug and/or bottom hose securely, set the temperature control to hot, and fill with coolant via the header tank, until up to the cold level indicator mark. On non-USA cars, the bleeding of air from the system may be speeded up by removing the bleed plug in the left hand headlamp pod well (raise headlamps), and refitting when a continuous stream of water flows out. Run the engine, and top up the header tank as necessary until the level stabilises or starts to rise. Stop the engine and allow to cool fully. Bleed the radiator again, top up the header tank to the cold indicator level, and fit the pressure cap.


USA type radiator drain plug

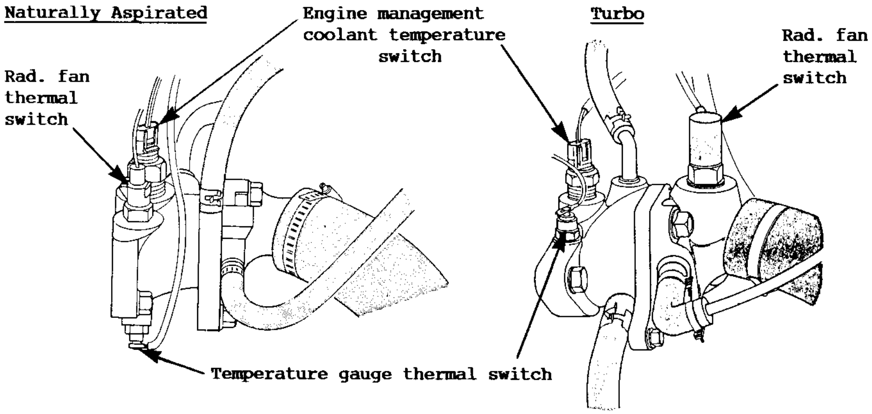

Non-USA type air bleed plug

KD.4 - RADIATOR FANS AND CONTROL

Two electric cooling fans are mounted on the rear of the radiator, and draw air through the radiator from front to rear.

Fan Control

A thermal switch fitted in the thermostat housing (N.A.) or outlet spout (Turbo), is used to control the radiator fans (and electric coolant pump). This switch should not be confused with two other sensors in the thermostat housing body, one for the engine management ECM, and one for the water temperature gauge. The rad. fans thermal switch senses the temperature of engine coolant, and energises the cooling fans when a temperature of 110°C is reached. The fans are


Naturally Aspirated
Engine management coolant temperature switch
Turbo
Rad. fan thermal switch
Rad. fan thermal switch
Temperature gauge thermal switch

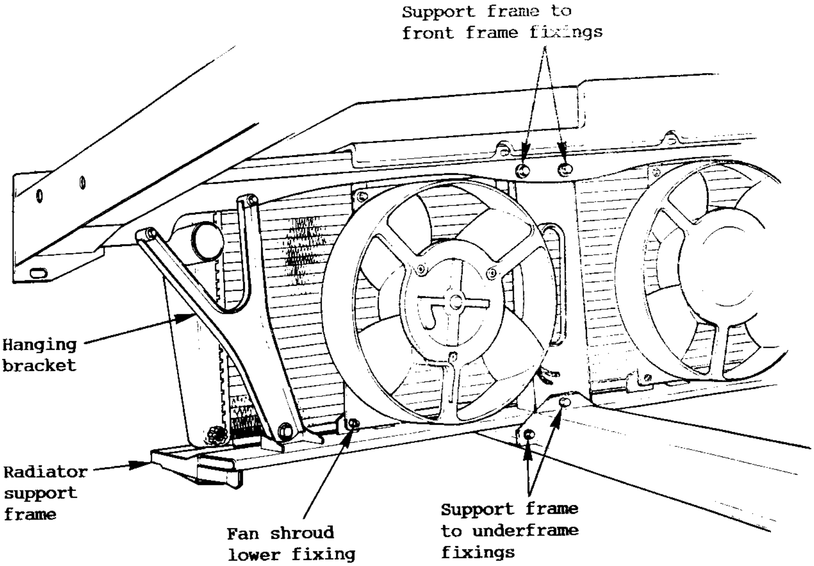
switched off when coolant temperature has dropped to 103°C (approx.). The fans are also controlled by a pressure switch in the a/c system receiver-drier to cool the condenser.

**WARNING:** Be aware that the cooling fans may run any time that the ignition is switched on, dependent on coolant temperature and a/c pressure. Keep fingers, hair, tools etc. well clear at all times.

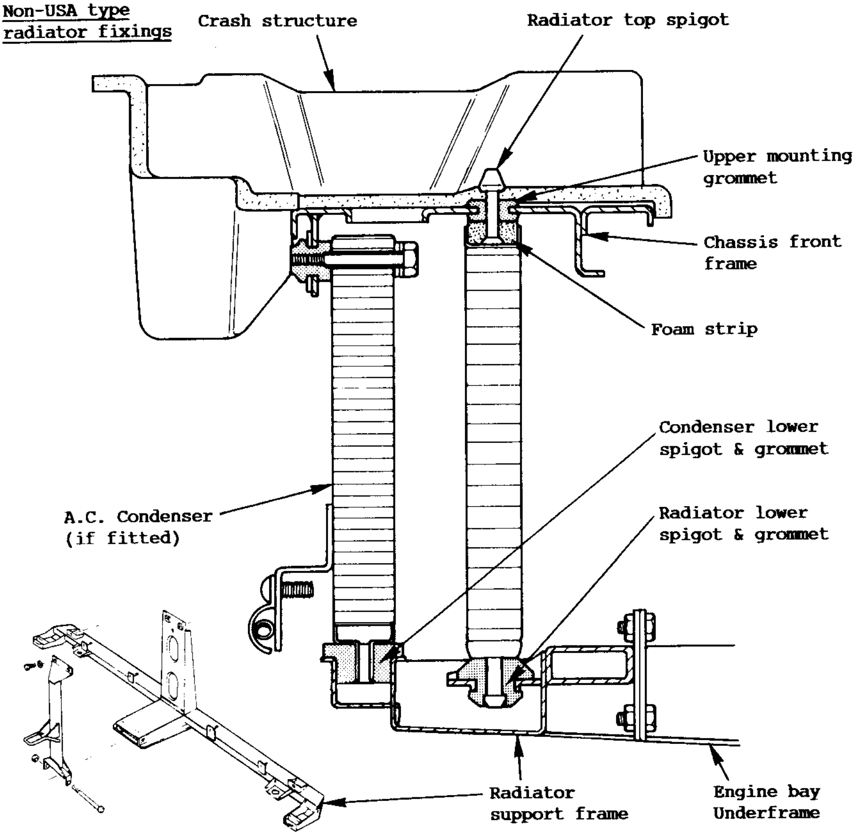
## KD.5 - ENGINE COOLING RADIATOR

Removal on non-USA cars:

1. Remove the radiator underpanel and drain the cooling system (see KD.4)
2. Disconnect the top and bottom radiator hoses.
3. Release the two lower fixings from each of the two fan shrouds, and unclip the water hose joiner pipe from the radiator support frame.
4. Disconnect the single fixing securing the hanging bracket to each side of the radiator support frame.
5. Release the centre strut ahead of the radiator, from the support frame.
6. Remove the three fixings securing the radiator support frame to the engine underframe, and disconnect the support frame centre bracket from from the chassis front frame (centre top behind the radiator).


Support frame to front frame fixings
Hanging bracket
Radiator support frame
Fan shroud lower fixing
Support frame to underframe fixings

**Non-USA type radiator fixings**


Crash structure
Radiator top spigot
Upper mounting grommet
Chassis front frame
Foam strip
Condenser lower spigot & grommet
A.C. Condenser (if fitted)
Radiator lower spigot & grommet
Radiator support frame
Engine bay Underframe

7. Carefully pull the support frame off the radiator bottom spigots by pushing upwards on the radiator and condenser (if fitted) spigots as the frame is pulled downwards.

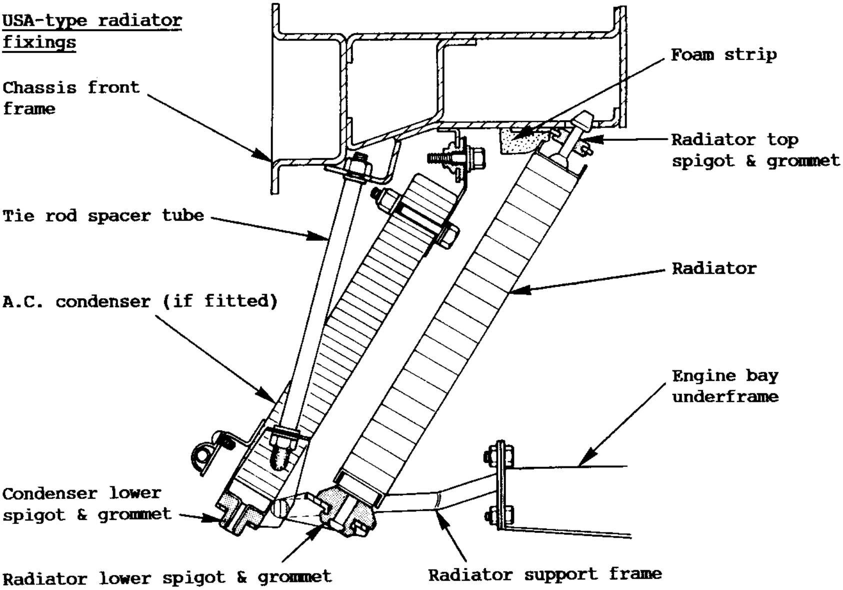
8. Carefully withdraw the radiator top two spigots from their grommets in the front frame.

Removal on USA cars:

The basic removal procedure is as for the non-USA type, except that the support frame and fixings are different. To remove the support frame, remove the three setscrews securing the frame to the front of the engine bay underframe, and remove the nut from the lower end of the tie rod at each side of the radiator.

Refitting

Before refitting the radiator, on domestic/export cars, check that the two lengths of sealing foam are fitted in the radiator top channel, and on USA cars that the sealing strip is fitted to the underside of the chassis front frame.


USA-type radiator fixings
Chassis front frame
Tie rod spacer tube
A.C. condenser (if fitted)
Condenser lower spigot & grommet
Radiator lower spigot & grommet
Radiator support frame
Foam strip
Radiator top spigot & grommet
Radiator
Engine bay underframe

Raise the radiator into position and fit the two top spigots into their grommets. Fit the radiator support frame engaging the lower spigots on the radiator and condenser (if fitted). Continue in the reverse order to removal. On USA cars, be sure to fit a plain washer at each end of the tie rod spacer tube, and beneath the nut. Fit the protective cap on the bottom end of the two tie rods.

After fitting, refill the system with a recommended coolant mix.

## KD.6 - CHARGECOOLER RADIATOR

The air/air chargecooler radiator is constructed from aluminium, with plastic end tanks, and is mounted in a composite duct to the left of the engine cooling radiator. The duct is secured to the chassis front frame or longeron, and also carries the engine intake air spout.

### Chargecooler Removal

1. Remove the left hand front wheelarch liner.
2. Release the chargecooler inlet and outlet hose connections.
3. Release the anti-roll bar hanging link(s).
4. Via the access hole in the front spoiler underside, remove the four M6 screws securing the chargecooler to the duct. Note that on non-USA cars, it is easier to release the chargecooler inboard end mounting plate from the duct. Carefully withdraw the radiator from the duct.

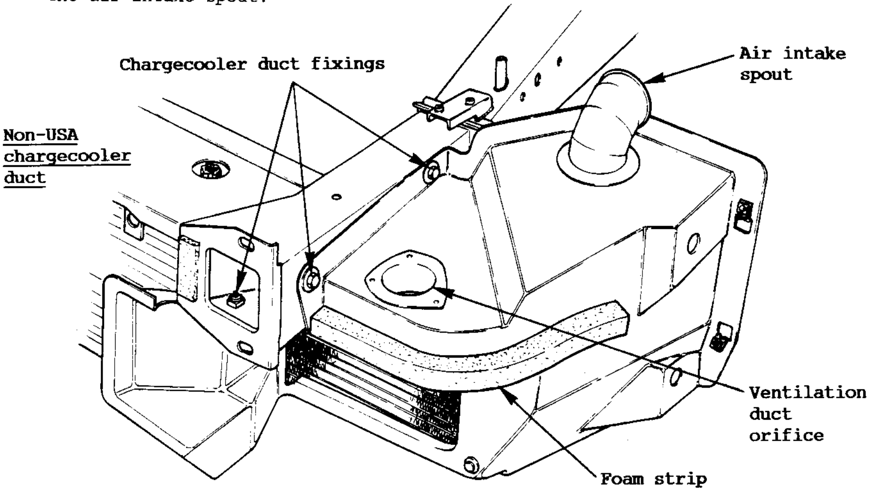
Before refitting the chargecooler, check that the foam sealing strip is fitted around the aperture.

Non-USA Type Chargecooler Duct Removal

1. Remove the left hand front wheelarch liner.

2. Remove the front bumper (see section BK.8).

3. Release the chargecooler inlet and outlet connections, and the trunking to the air intake spout.



4. Remove the three M8 fixings securing the duct to the chassis front frame - two into the side of the frame, and one in the front underside. Withdraw the duct complete with chargecooler.

On re-assembly, check that the foam strip is fitted around the outside corner of the duct to seal against the bumper. Note that on RHD cars, an orifice in the top surface of the duct provides additional airflow to the cabin ventilation duct, moulded into the underside of the topshell.

USA Type Chargecooler Duct Removal

1. Remove the left hand front wheelarch liner.

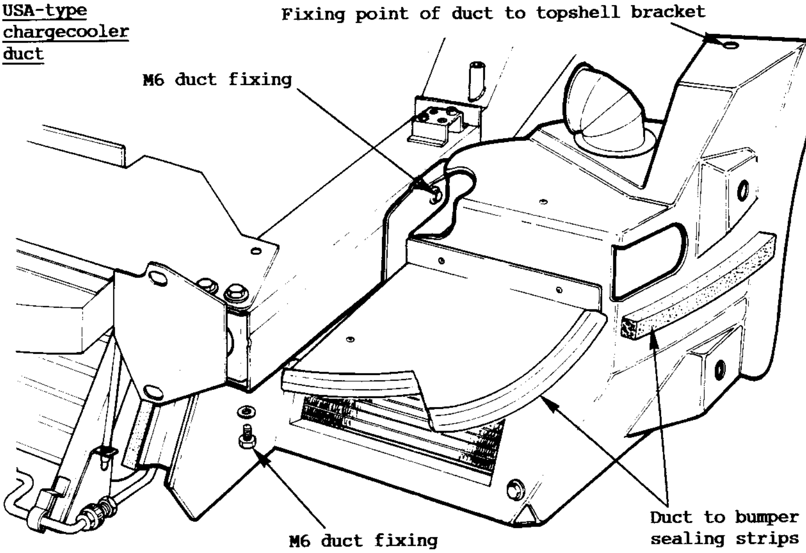
2. Remove the front bumper (see section BK.8).

3. Release the chargecooler inlet and outlet connections, and the trunking to the air intake spout.

4. Remove the support bracket securing the top rear of the duct to the topshell.

5. Remove the two M6 fixings securing the duct to the chassis longeron - one into the side of the longeron, and one in the front underside. Withdraw the duct complete with chargecooler.

On re-assembly, check that the foam strip and two lengths of hollow edging strip are fitted to the duct to seal against the bumper.


USA-type chargecooler duct
Fixing point of duct to topshell bracket
M6 duct fixing
M6 duct fixing
Duct to bumper sealing strips

KD.7 - OIL COOLER RADIATOR

The oil cooler radiator is mounted in a composite duct to the right of the engine cooling radiator. The duct is secured to the chassis front frame or longeron, and also carries the two horns.

Oil Cooler Radiator Removal

1. Remove the right hand front wheelarch liner.

2. Disconnect the horn leads, and remove the horn bracket complete with horns after releasing the two top fixings, and single lower horn bracket fixing.

3. Release the a.c. hose fixings from the duct (if fitted), and disconnect the anti-roll bar hanging link(s).

4. Release the two banjo bolt oil cooler connections, using a shop towel to absorb the escaping oil.

5. Via the access hole in the front spoiler underside, release the four M6 fixings securing the oil cooler radiator to the duct, and carefully withdraw the radiator.

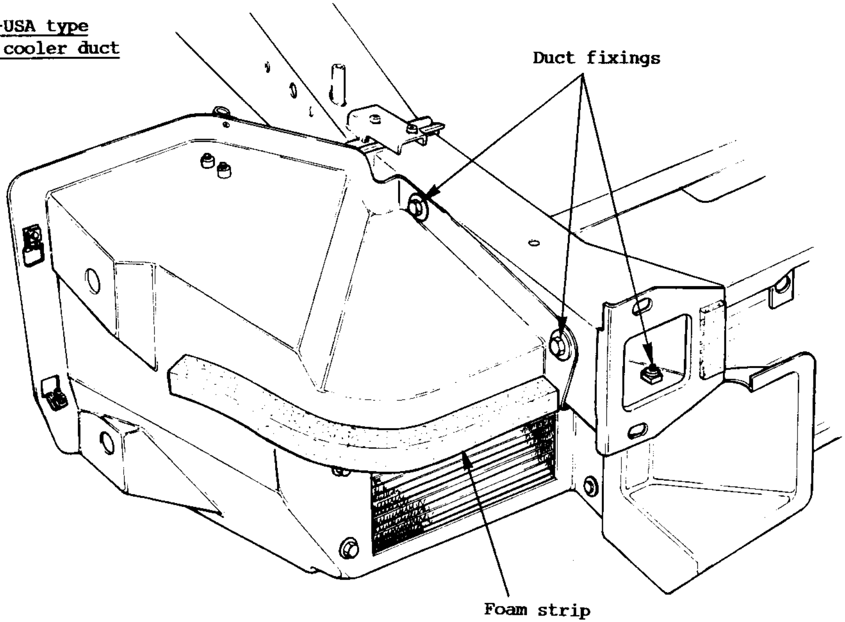
When re-fitting the oil cooler, note that the banjo connections use 'Dowty' sealing washers which should be renewed each time the banjo bolts are released. Torque tighten the banjo bolts to 27 Nm (20 lbf.ft).

Oil Cooler Radiator Duct Removal

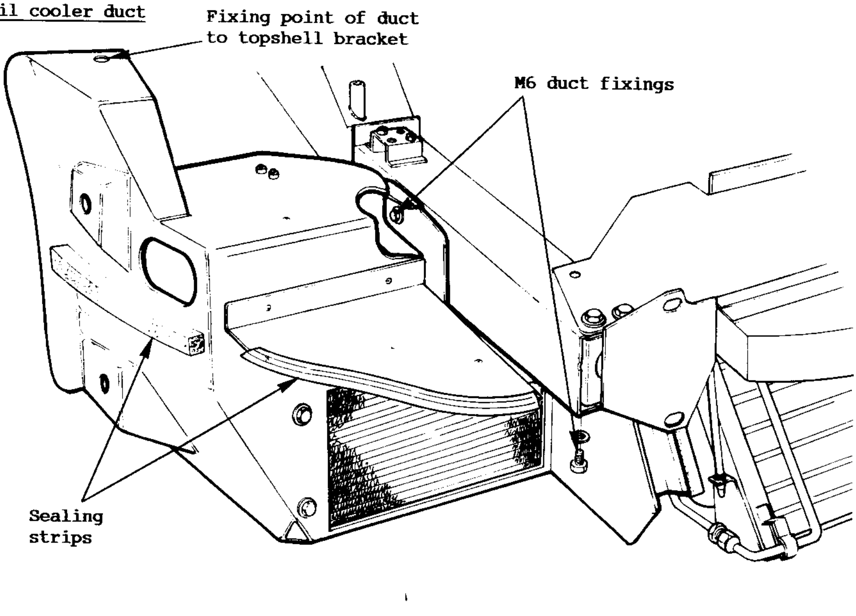
1. Remove the right hand front wheelarch liner.

2. Remove the front bumper (see section BK.8).

Non-USA type
oil cooler duct


Duct fixings
Foam strip

USA type
oil cooler duct


Fixing point of duct to topshell bracket
M6 duct fixings
Sealing strips

3. Release the two oil cooler hoses at their connections at the back of the engine using a shop towel to absorb the escaping oil. Release the two hose tie-wraps.

4. Disconnect the horn leads, and on a.c. cars, remove the horns mounting bracket. Release the fixings securing the a.c. pipe to the duct.

5. Remove the duct fixings:
   Non-USA cars:- Two M8 setscrews into the side of the chassis front frame (weldnuts); One M8 setscrew into the front underside of the front frame (weldnut).
   USA cars:- Release the support bracket between the top rear of the duct and the topshell; One M6 screw into the side of the longeron (weldnut); One M6 setscrew into the front underside of the longeron (weldnut).

6. Withdraw the duct complete with oil cooler and pipes.

On re-assembly, check that the foam strip, and hollow rubber edging strip (USA cars) are fitted to the front of the duct to seal against the bumper. Note that on non-USA type LHD cars, an orifice in the top surface of the duct provides additional airflow to the cabin ventilation duct, moulded into the underside of the topshell.

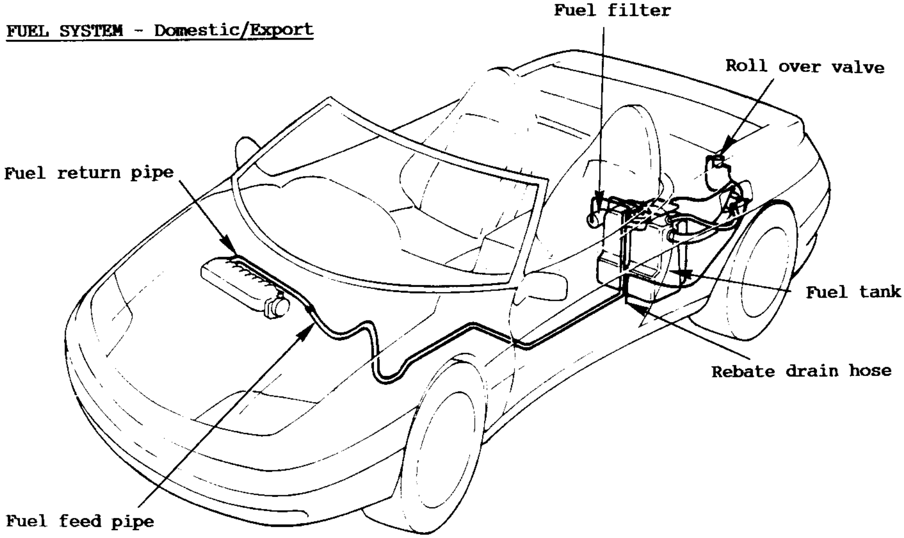
Check that the two oil cooler hoses are protected by Armaflex sleeving, and torque tighten the oil feed and return hose connections at the back of the engine to 27 Nm (20 lbf.ft).

# FUEL SYSTEM

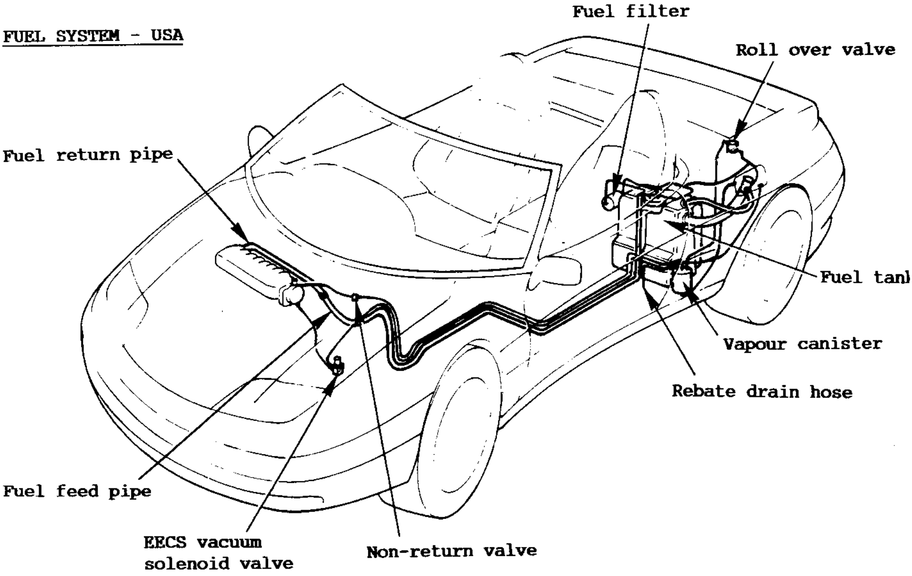
## SECTION LG - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | LG.1 | 4 |
| Precautions | LG.2 | 5 |
| Fuel Pump/Sender Unit | LG.3 | 5 |
| Fuel Tank | LG.4 | 8 |
| Fuel Filter | LG.5 | 14 |
| Fuel Filler Flap | LG.6 | 14 |
| Fuel Filler Neck | LG.7 | 16 |
| Evaporative Emission Control System (EECS) (Catalyst cars only) | LG.8 | 18 |

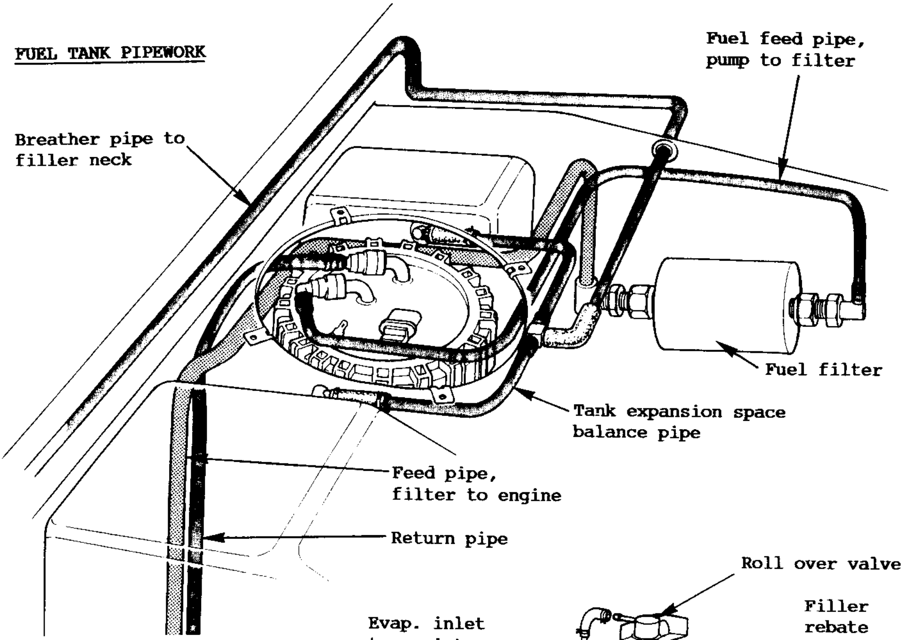
FUEL SYSTEM - Domestic/Export


Fuel filter
Roll over valve
Fuel return pipe
Fuel tank
Rebate drain hose
Fuel feed pipe

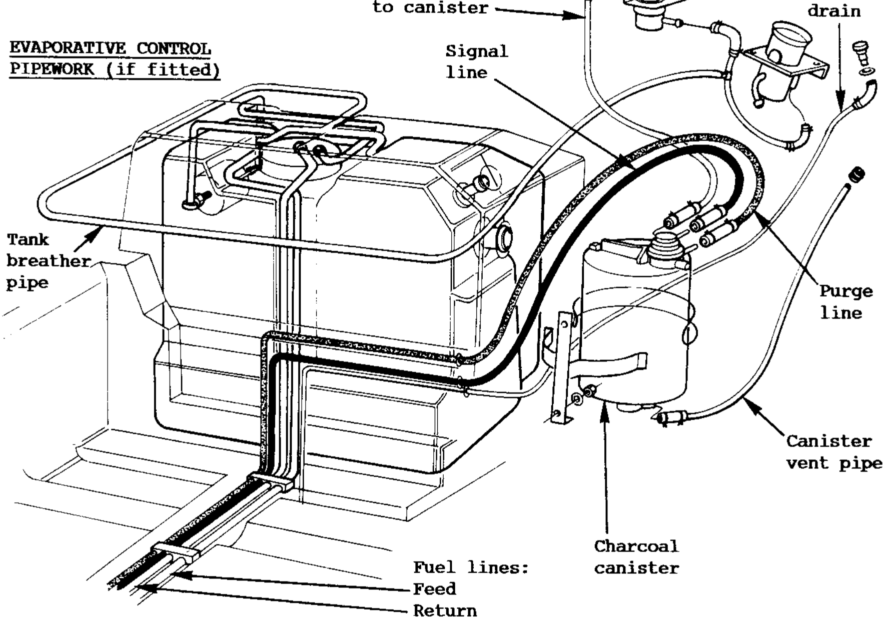
FUEL SYSTEM - USA


Fuel filter
Roll over valve
Fuel return pipe
Fuel tanl
Vapour canister
Rebate drain hose
Fuel feed pipe
EECS vacuum solenoid valve
Non-return valve

## FUEL TANK PIPEWORK


Breather pipe to filler neck
Fuel feed pipe, pump to filter
Fuel filter
Tank expansion space balance pipe
Feed pipe, filter to engine
Return pipe

## EVAPORATIVE CONTROL PIPEWORK (if fitted)


Roll over valve
Evap. inlet to canister
Filler rebate drain
Signal line
Tank breather pipe
Purge line
Canister vent pipe
Charcoal canister
Fuel lines:
Feed
Return

## LG.1 - GENERAL DESCRIPTION

The single fuel tank is moulded from impact resistant blow moulded high density polyethylene for light weight and freedom from corrosion, and is mounted ahead of the left hand rear wheel by two stainless steel bands.

The fuel pump is a roller vane type, high pressure electric pump mounted submerged within the fuel tank. A fuel strainer is attached to the fuel pump inlet line and prevents dirt particles from entering the fuel line and tends to separate water from the fuel. A pulsator, fitted immediately above the fuel pump, reduces pressure pulsations in the supply line. The whole assembly of pump, strainer and pulsator is fixed (by the supply and return pipes), to a mounting plate secured by a threaded ring to the top face of the tank. Also incorporated into this assembly is the fuel level sender unit, which uses a nylon float and a rheostat to supply a signal to the fuel gauge.

The pump supplies fuel at a pressure of 211 - 379 kPa (30.5 - 55 psi) dependent on operating conditions, through an in line canister type filter located adjacent to the tank, to the fuel injector rail assembly on the engine. Nylon pipes are used to carry the fuel to and from the engine, and are routed alongside the chassis centre section. A compression joint is used between the high pressure supply pipe and the fuel rail inlet pipe at the back of the engine. Special tool T000T1083F may be fitted at this point in order for the fuel pump performance to be tested. See EMJ/EMK/EML. The low pressure return pipe uses a connector hose and spring clamps at its joint with the fuel rail return pipe. Special push-on fittings are used on both pipes at the connections to the fuel pump assembly, and require a special tool T000T0898 to release the connectors. Each connector uses two 'O' rings to seal against the spigots on the fuel pump assembly, and may require replacement of the seals if the joint is opened repeatedly.

The pump is able to deliver 4 - 5 times the engine's maximum requirement, so that fuel is constantly circulated through the in-line fuel filter, fuel rail, and via the fuel pressure regulator, back to the tank. This fuel circulation helps avoid excessive fuel temperature with the consequent risk of vapour locks.

When the ignition is switched on, the engine management ECM energises the fuel pump which will continue to run for as long as the ECM receives ignition pulses from the ignition module (engine cranking or running). If no ignition pulses are received, the ECM switches off the pump either 2 seconds (approx) after the ignition was switched on, or about 10 seconds after a stall.

A roll over valve is mounted on the top left hand side of the rear bulkhead, and is connected between the breather spigot on the fuel filler neck, and the fresh air vent fitted at the top of the filler recess in the body. This valve allows venting of the tank under normal circumstances, but prevents fuel spilling from the vent pipe if the vehicle is inverted in an accident.

On catalyst equipped vehicles fitted with an evaporative emissions control system (EECS), the vent side of the roll over valve is connected to a vapour storage charcoal canister mounted behind the LH 'B' post. When the engine is stopped, the fuel vapour from the tank is absorbed by charcoal in the canister. When the engine is running, the fuel vapour is purged from the charcoal by a flow of air through the unit, which is then consumed by the engine in the normal combustion process. This purging process is controlled by a diaphragm valve on the top of the canister, and a vacuum solenoid valve in the engine bay, which is itself controlled by the engine management ECM. Full details of the charcoal canister evaporative loss system for USA specification models, and of the fuel rail, pressure regulator and fuel injectors for all models, are contained in the separate publications Service Notes Sections EMJ/EMK/EML.

In order to maintain an expansion space within the fuel tank to allow for changes in ambient and fuel temperature, the filler breather dip tube projects into the tank and defines the tank full level. Prior to December 1990, a small hole in this tube allowed communication between the expansion space and the filler neck. In December 1990, the tank breather system was revised to provide a greater tolerance to parking on a severe side slope with a full tank. This consisted of a connection pipe between the tank expansion space balance pipe and the breather pipe from filler neck to roll over valve, and the deletion of the dip tube hole. For details see section LG.4.

## LG.2 - PRECAUTIONS

i) To minimise the risk of fire and personal injury, relieve the fuel system pressure before servicing the fuel rail or any related component. See 'Fuel Pressure Relief Procedure' below.
ii) To reduce the possibility of sparks occurring when a fuel line is disconnected, or when fuel vapour is present, the negative battery cable should be disconnected before work is commenced.
iii) When fuel lines are disconnected, absorb any escaping fuel in an absorbent cloth and dispose of safely.

### Fuel Pressure Relief Procedure

This procedure should be used prior to disconnecting any part of the fuel line except the unpressurised return line.

- Trip the inertia switch (in battery compartment (RHD) or LH speaker box (LHD)) to disconnect the fuel pump feed, and start the engine.
- After the engine stops from fuel starvation (crank for at least 60 secs if non starter), crank for at least 5 seconds to reduce the remaining fuel pressure.
- Disconnect the battery.
- Use a shop towel to absorb the small amount of pressurised fuel remaining as a fuel feed pipe connection is released.

## LG.3 - FUEL PUMP/SENDER UNIT

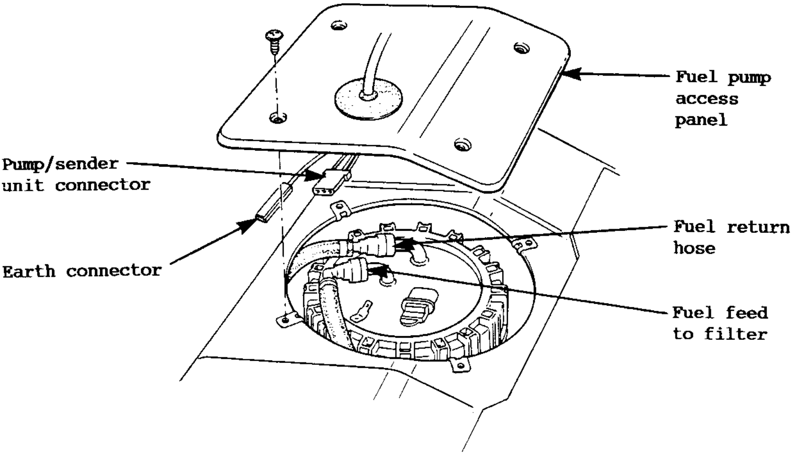
To test the fuel pump performance, see separate manuals EMJ/EMK/EML.

### To Remove Fuel Pump

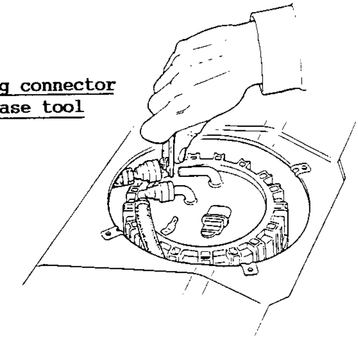
**WARNING:** Before commencing work, carry out fuel pressure relief procedure detailed above, and disconnect the negative battery cable.

1. Remove the roof stowage compartment floor, followed by the fuel pump access panel above the tank.

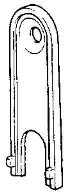
2. Disconnect fuel feed and return lines from fuel pump assembly. The 'Speedfit' fuel pipe connectors are released by using a two prong tool (T000T0989) inserted into the holes in the connector end; press in to release the grip collar and pull each connector off the feed and return spigots. Use an absorbent cloth to soak up the small amount of fuel expelled under residual pressure. Unplug the electrical connector and earth lead.
If the connector shows any evidence of leaking, or is very difficult to release, the connector 'O' rings should be replaced. Early cars were fitted with two nitrile (black) 'O' rings, the swelling of which could cause difficult release of the pipe connector.


Fuel pump access panel
Pump/sender unit connector
Earth connector
Fuel return hose
Fuel feed to filter

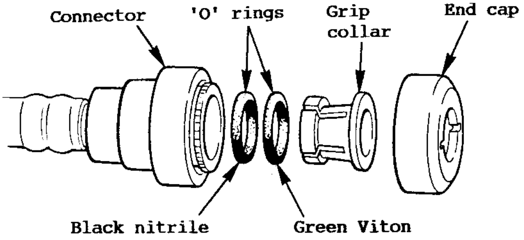
Using connector release tool



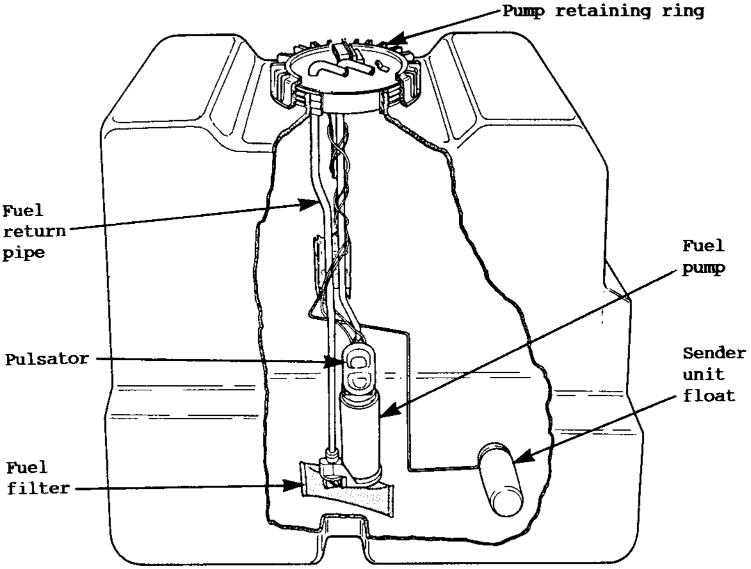
T000T0989



To renew connector 'O' rings:
- Prise off the end cap of the connector;
- Pull out the gripper collar;
- Remove the two 'O' rings from within the connector;
- Fit into the connector the nitrile (black) seal A100L6039S followed by the Viton (green) seal A100L6038S, and refit the gripper collar and end cap.

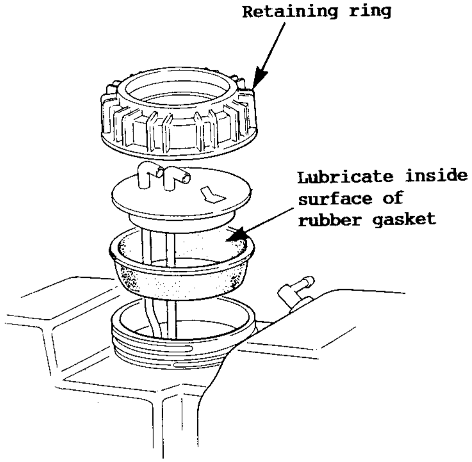

Connector
'O' rings
Grip collar
End cap
Black nitrile
Green Viton

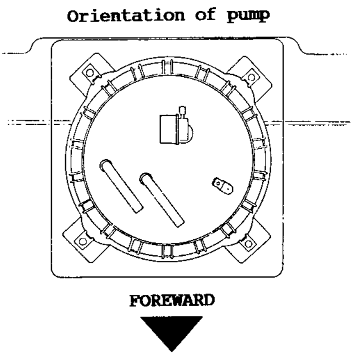
3. Unscrew the fuel pump retaining ring to release the fuel pump assembly and withdraw complete fuel pump/gauge sender unit assembly using an absorbent cloth to catch dripping fuel.


Pump retaining ring
Fuel return pipe
Fuel pump
Pulsator
Sender unit float
Fuel filter

4. Temporarily cap fuel tank aperture to reduce fire risk.

To Replace


Retaining ring
Lubricate inside surface of rubber gasket


Orientation of pump
FOREWARD

1. Before re-fitting the pump assembly, check the condition and cleanliness of the pump filter. Check that the rubber seal is in good condition, and fit the seal into the tank aperture. Smear the inside surface of the seal with engine oil to ensure proper seating of the pump before feeding the assembly into the tank and retaining with the threaded ring. Ensure that the pump is positioned (orientated) as shown in the diagram before tightening the ring as fully as possible with the fingers. Mark the position of the ring, and use a hardwood or plastic drift and a mallet to further tighten the ring a ¼ turn. Recheck orientation after tightening.

2. Refit the feed and return pipes to the pump spigots (return pipe - straight connector - first) and connect the fuel pump harness and earth lead, but before fitting the access cover, reset the inertia switch, connect the battery, and start the engine to check for leaks from the fuel pipe connections.

3. Refit the fuel pump access panel and trim panels.

## LG.4 - FUEL TANK

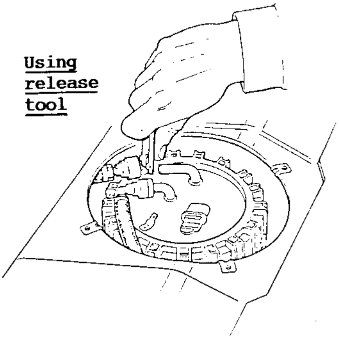
### To Remove

**WARNING:** Before commencing work, carry out the fuel pressure relief procedure detailed in LG.2. Drain the tank by syphoning to lighten the weight and reduce the danger of fuel spillage.

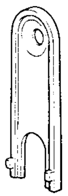
1. Remove the roof stowage compartment floor, and fuel pump access panel. Disconnect the pump/sender unit electrical plug and earth cable.

2. Use tool T000T0989 to disconnect the fuel feed and return lines from the fuel pump assembly: Fit the two pips on the legs of the tool into the holes in the end of the 'Speedfit' connector, and press in to release the grip collar whilst pulling back on the connector body. Use an absorbent cloth to soak up the small amount of fuel expelled under residual pressure. If the connector shows any evidence of leaking, or is very difficult to release, the connector 'O' rings should be replaced. See section LG.3.

**Using release tool**

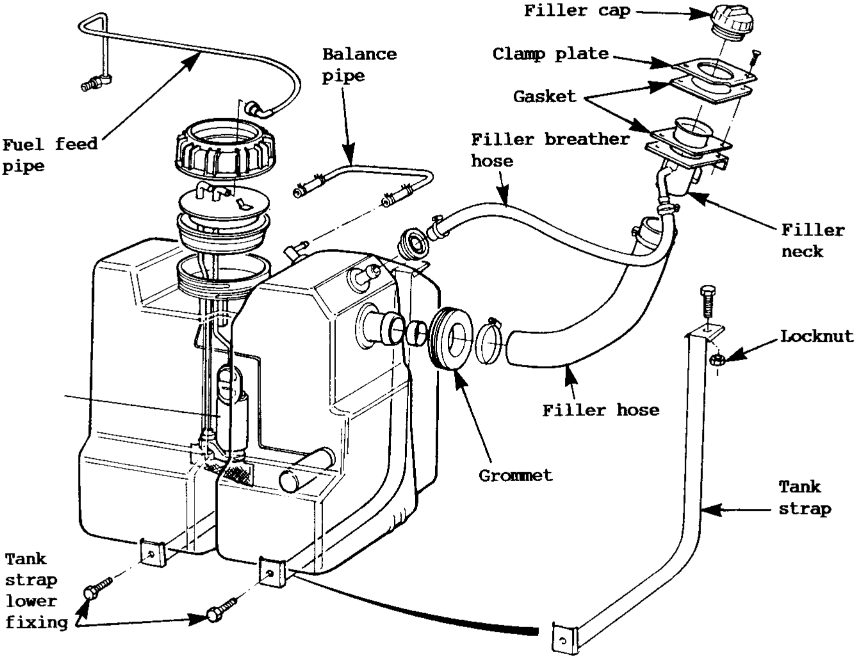


**T000T0989**



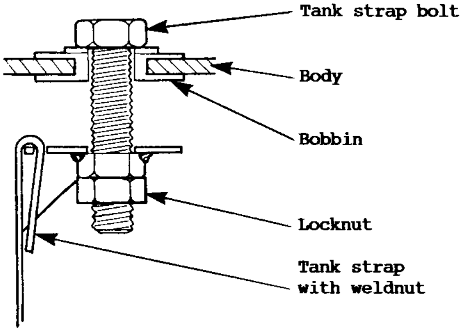
3. Release both ends of the tank balance pipe from the tank spigots, and cap the spigots. (It may be easier to do this as the tank is being lowered)

4. Disconnect the filler and filler breather hoses from the tank, and plug the orifices.


Filler cap
Balance pipe
Clamp plate
Gasket
Fuel feed pipe
Filler breather hose
Filler neck
Locknut
Filler hose
Grommet
Tank strap
Tank strap lower fixing

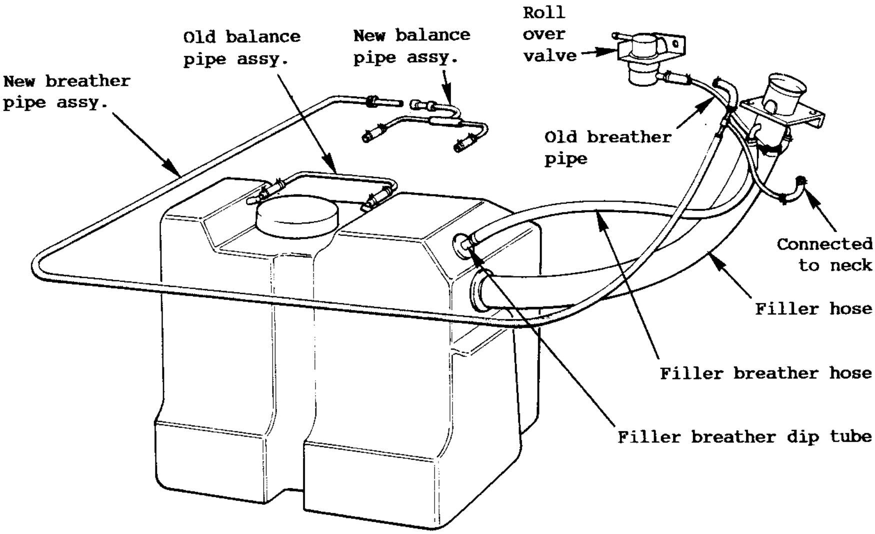
5. To provide room for the tank to drop, the left hand lower wishbone must be lowered: Release the parking brake cable from the caliper lever, and remove the top wishbone to hub carrier bolt. Match mark the position of the toe-in adjustment eccentric before slackening the two lower wishbone to chassis bolts. Release the anti-roll bar from the lower wishbone, and the bolt securing the anti-roll bar hanging link to the chassis. Remove the damper to lower wishbone bolt, and lower the wishbone and hub carrier assembly without straining the brake hose.

6. Release the locknut from the underside of the two tank strap top fixing bolts and unscrew each bolt. Swing down the two straps and carefully lower the tank, easing the filler stub through the body.


Tank strap bolt
Body
Bobbin
Locknut
Tank strap with weldnut

## Fuel Tank Breather Revision

A revised fuel tank breather system was introduced on all Elan models from December 1990, VIN: M 6634. Prior to the changepoint, the connection between the expansion space of a full tank and the filler neck breather take off, was made via a small hole in the filler breather dip tube. If the vehicle is parked on a severe side slope with a full tank, it is possible for this hole to be covered, and tank breathing problems result. From the changepoint, the dip tube hole was deleted, and a new breather pipe introduced to connect between the expansion space balance pipe and the filler neck to roll over valve pipe.

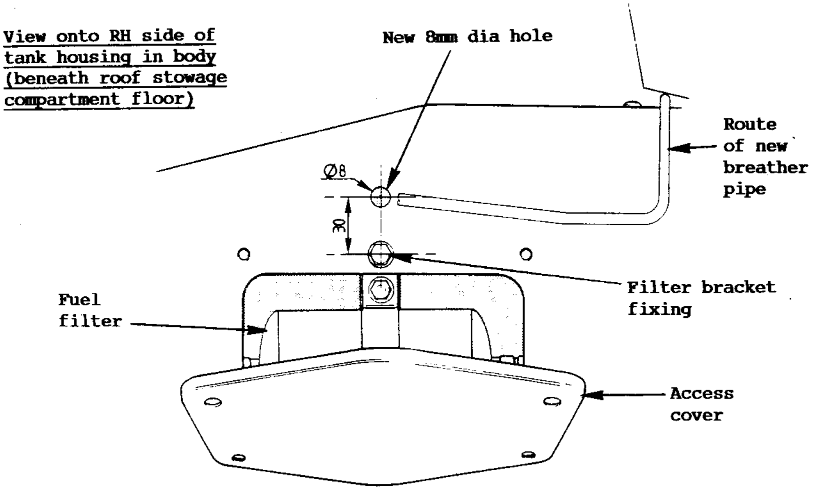


For service replacement, early type tanks (B100L0087F) should be fitted to cars prior to the changepoint, until stocks are exhausted. After this time, the later type tank (D100L0087F) should be fitted together with the updated breather system as detailed below. Failure to use the later type breather system with the 'D' type tank may, in certain circumstances, result in expulsion of fuel from the breather pipe, or **cause fuel to spurt from the filler neck as the cap is removed.**

'D' tanks may be identified by a white 'D' marked on the top surface of the tank. To fit a 'D' type tank to an earlier car when stocks of 'B' tanks are exhausted, order the following parts:

| | | |
|---|---|---|
| Fuel Tank Assembly (inc. pump and gauge sender) | D100L0087F | 1 off |
| Pipe Assembly, expansion volume balance | A100L0139F | 1 off |
| Pipe Assembly, fuel tank breather | A100L0140F | 1 off |
| Grommet, breather pipe | A100L6006F | 1 off |

i) Drill an 8 mm diameter hole in the body for the new breather pipe, 30 mm up from the fuel filter bracket top fixing. Fit and seal the grommet A100L6006F.

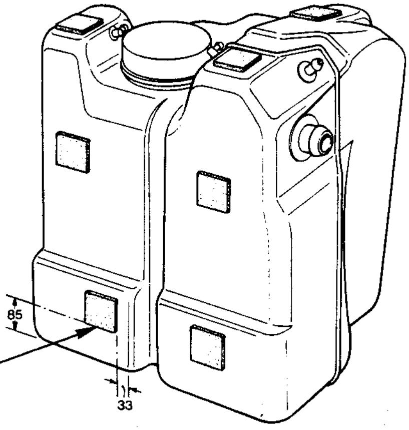

View onto RH side of tank housing in body (beneath roof stowage compartment floor)
New 8mm dia hole
Ø8
30
Route of new breather pipe
Fuel filter
Filter bracket fixing
Access cover

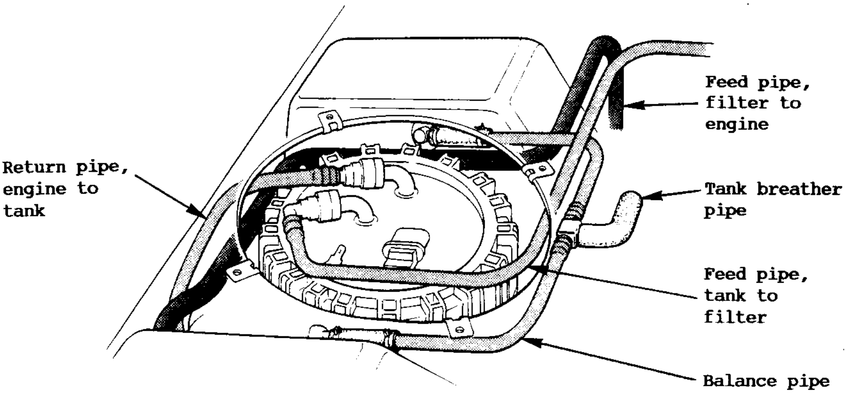
ii) Fit the end of the new breather pipe through the grommet, and push fully into the connector on the balance pipe assembly.

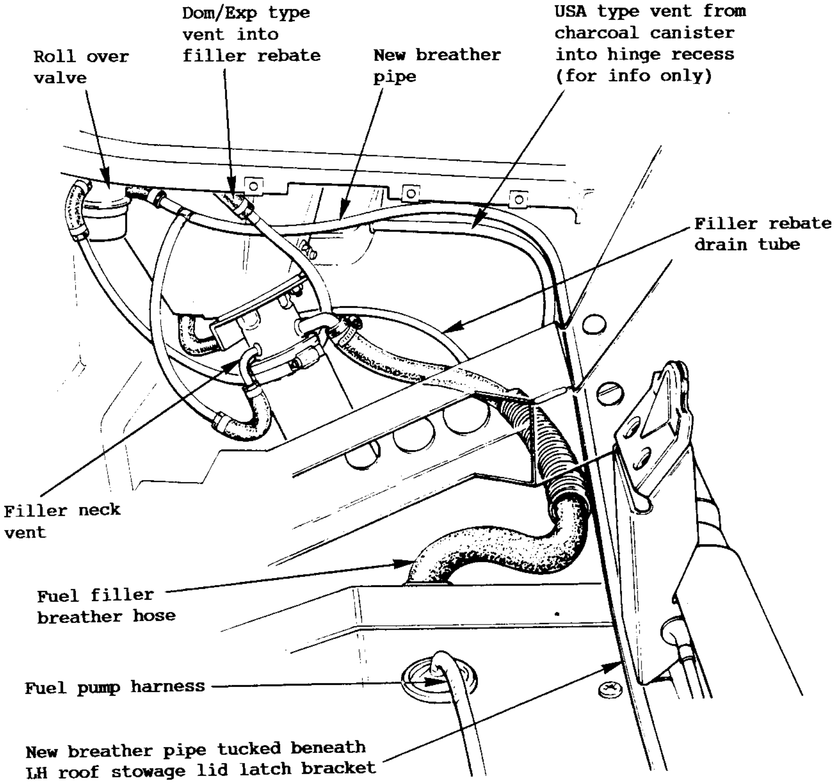
iii) Route the new breather pipe around the front of the hood stowage compartment and into the filler neck area. Remove and discard the existing breather pipe between the filler neck and roll over valve. Fit the new pipe to the filler neck and roll over valve, ensuring that all joints are firmly retained by the spring clips. Tuck the breather pipe beneath the LH roof stowage lid latch bracket. See later illustration.

To Refit Tank

1. Check that the tank is fitted with seven foam rubber pads, and that the pads are in good condition. If necessary, renew and use Silastic RTV 732 adhesive (A036E6038) to secure the pads.
   Note that all the pad positions except the RH lower on the tank front face are indicated by moulded corner lines on the tank.

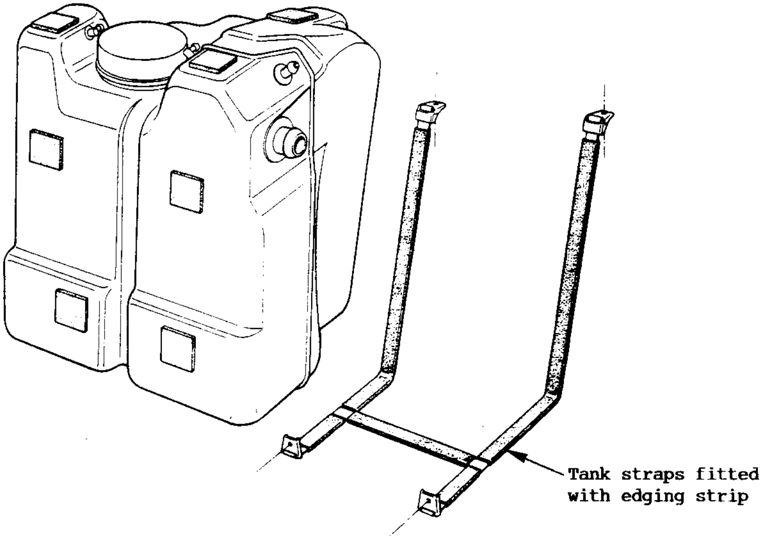

85
33
Position RH lower pad as shown


Return pipe, engine to tank
Feed pipe, filter to engine
Tank breather pipe
Feed pipe, tank to filter
Balance pipe


Roll over valve
Dom/Exp type vent into filler rebate
New breather pipe
USA type vent from charcoal canister into hinge recess (for info only)
Filler rebate drain tube
Filler neck vent
Fuel filler breather hose
Fuel pump harness
New breather pipe tucked beneath LH roof stowage lid latch bracket

2. Remove the filler and filler breather tube grommets from the body before fitting the tank into position. As the tank is raised, check that the feed pipe from the filter to the engine is routed correctly, and fit the balance pipe onto the two tank spigots, checking that all connections are secure and retained with spring clips. Push the fuel feed and return connections onto the tank spigots.

3. Ensure that the tank straps are fitted with rubber edging strip; either glued onto each edge, or one piece edging strip fitted without glue.



Fit the tank strap bolts taking care not to cross thread , and hold the weldnuts with an 18 mm deep socket to prevent the straps twisting whilst the bolts are tightened to 12 Nm (9 lbf.ft). Fit and tighten the locknuts from beneath.

4. Fit the filler neck and filler breather tube grommets. Connect the filler hose, ensuring that the hose is pushed through the grommet, and secure with the hose clip. Fit and secure the filler breather hose, checking that it is routed beneath the seat belt reinforcing strut, and is protected with convoluted sleeving.

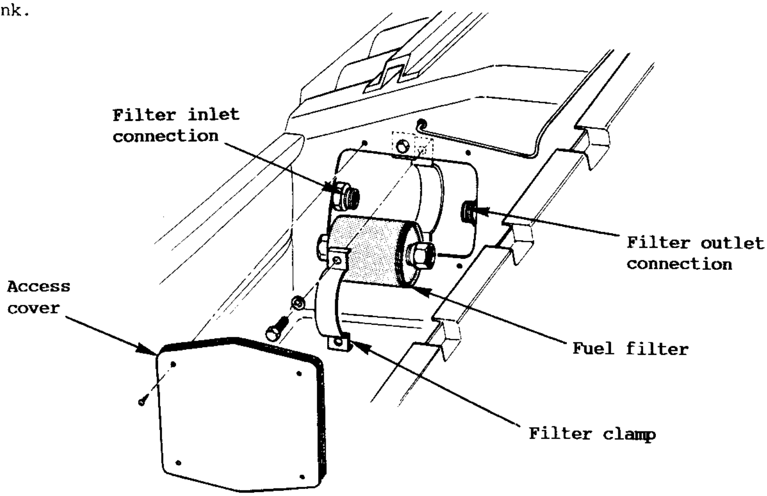
5. Re-assemble the rear suspension referring to Section DD, and tighten the pivot bolts only with the vehicle at ride height. Ensure the toe-in adjustment eccentric match marks are aligned.

6. Before refitting the pump access panel and roof stowage compartment floor, fill the tank, connect the battery, reset the inertia switch and start the engine to check for leaks from the fuel pipe connections.

7. Fit the access panel and roof stowage compartment floor.

## LG.5 - FUEL FILTER

The fuel filter should be renewed at intervals specified in the maintenance schedule. Access to the fuel filter is available after removing the roof stowage compartment floor, via a removeable panel in the body to the right of the fuel tank.



**WARNING:** The fuel in the filter and connecting pipework is pressurised. Before commencing work, carry out the fuel pressure relief procedure detailed in section LG.2.

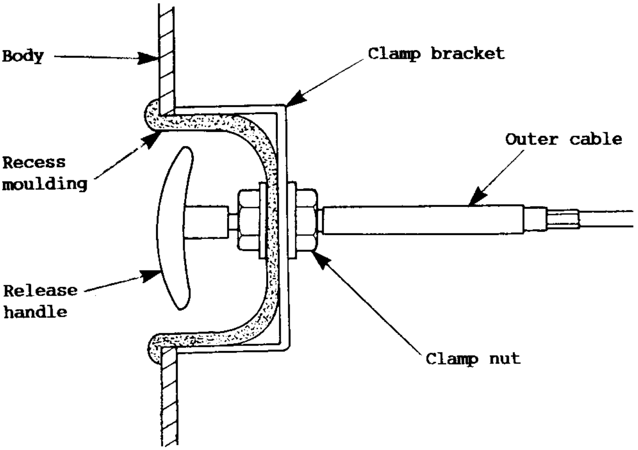
Compression joints are used at each end of the filter, necessitating the use of two spanners when slackening or tightening the connections. To replace the filter, release the inlet and outlet connections using an absorbent cloth to soak up the small amount of fuel expelled under residual pressure. Release the two clamp bolts, remove the clamp, and withdraw the filter.

Fit the new filter into position with the direction of flow arrow pointing forwards, and tighten the unions to 27 Nm (20 lbf.ft). Refit the clamp, tighten the two clamp bolts, and refit the access cover and gasket.

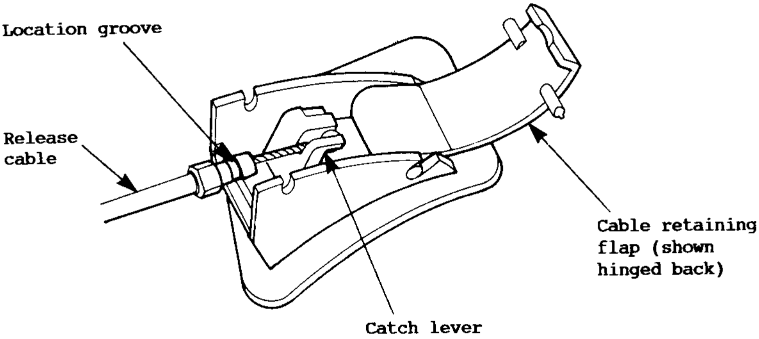
## LG.6 - FUEL FILLER FLAP

The fuel filler flap uses a spring catch which is released by a cable terminating in a release handle in the left hand door jamb. On early cars, the recess for the handle comprises a separate black plastic moulding, but on later cars, the recess is incorporated into the body (door jamb) moulding. The handle is integral with the inner cable and a 'U' shaped clamp bracket, secured to the outer cable, clamps the cable (and handle recess moulding if applicable) into the body aperture. For access to the clamp, the hood stowage compartment left hand trim panel must first be removed.

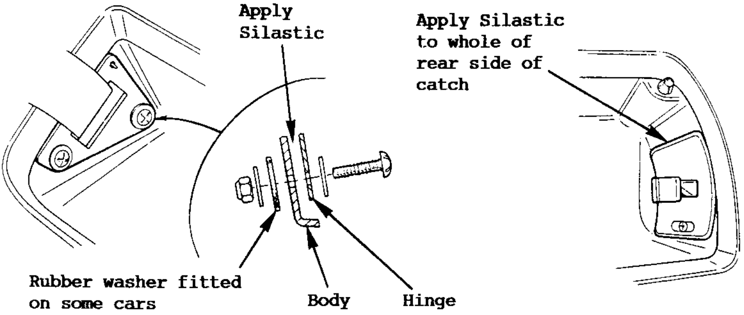
To remove a cable, the catch end must first be released, before the handle end clamp nut is removed and the cable withdrawn through the clamp bracket and body.


Body
Clamp bracket
Outer cable
Recess moulding
Release handle
Clamp nut

The filler flap catch end of the cable uses a ball nipple to hook into the catch lever, and a groove in the outer cable which locates in the catch body, and is retained by a hinged flap which clips into position. Prise open the flap to release the cable.


Location groove
Release cable
Cable retaining flap (shown hinged back)
Catch lever

The catch is retained in the body by a single screw, which allows adjustment of filler flap shutlines. If the catch is removed, apply black Silastic to the whole of the catch flange before refitting. Filler flap shutlines may also be adjusted via slotted fixing holes in the hinge bracket. If refitting a hinge bracket, ensure that Silastic is applied between the inside surface of the body and the hinge bracket.


Apply Silastic
Apply Silastic to whole of rear side of catch
Rubber washer fitted on some cars
Body
Hinge

LG.7 - FUEL FILLER NECK

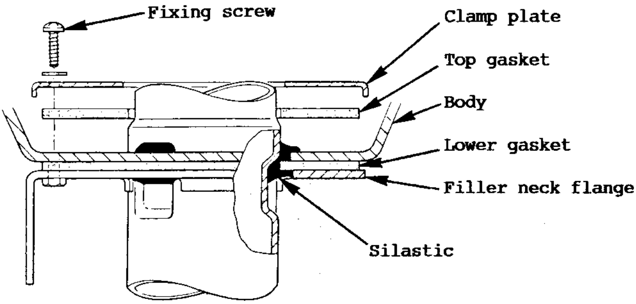
The filler neck is retained in the filler recess by two screws which clamp a flange on the neck to a clamp plate in the recess, with a rubber gasket used each side of the body. The filler cap incorporates a torque limiting ratchet mechanism to prevent overtightening, and a pressure relief valve to prevent damage caused by a rapid pressure rise which the restricted breather line is unable to control.

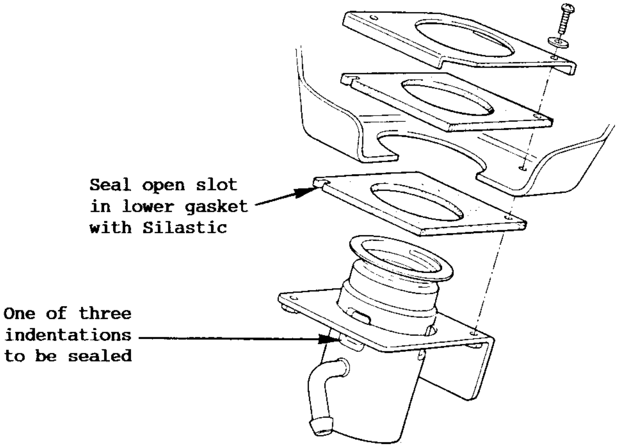
Access to the filler neck is available after removing the roof stowage compartment trim panels. It is important when refitting the filler neck, that complete weathersealing is achieved by the following procedure:

1. With a sealing gasket fitted onto the filler neck mounting flange, use black Silastic to seal the three indentations in the neck (from beneath the flange) and between the inside edge of the gasket and the filler neck. Also seal the fixing screw open slot in the gasket.

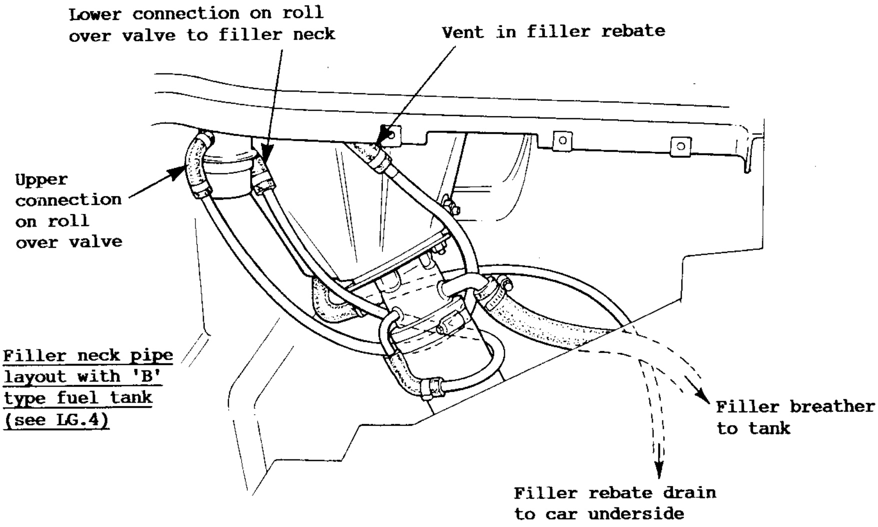
2. Fit the filler neck into position and push upwards against the body whilst using Silastic to seal between the filler neck and the body.

3. Fit the top gasket and plate, and tighten the two screws.


Fixing screw
Clamp plate
Top gasket
Body
Lower gasket
Filler neck flange
Silastic

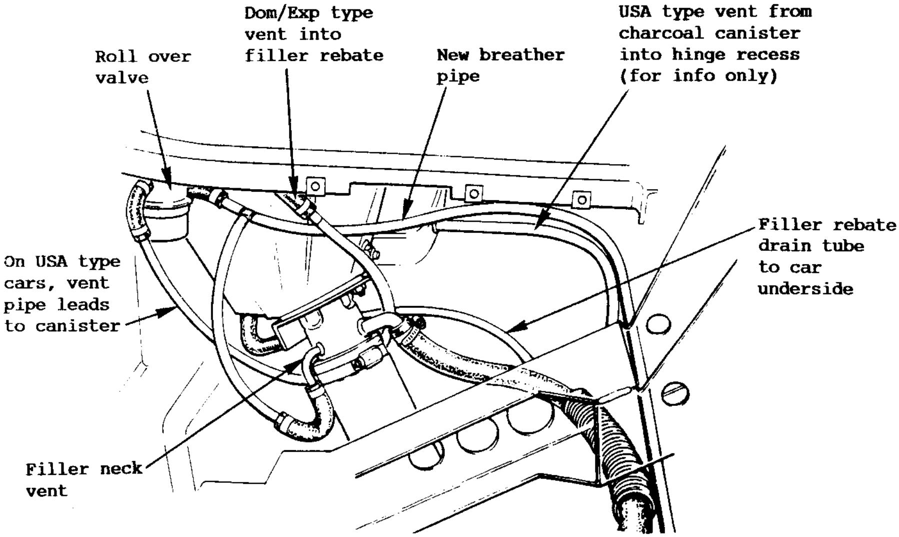

Seal open slot
in lower gasket
with Silastic
One of three
indentations
to be sealed

4. Refit the filler and breather hoses.


Lower connection on roll
over valve to filler neck
Vent in filler rebate
Upper
connection
on roll
over valve
Filler breather
to tank
Filler rebate drain
to car underside

Filler neck pipe layout with 'B' type fuel tank (see LG.4)

Filler neck pipe layout with 'D' type fuel tank (see LG.4)


Roll over valve
Dom/Exp type vent into filler rebate
New breather pipe
USA type vent from charcoal canister into hinge recess (for info only)
Filler rebate drain tube to car underside
On USA type cars, vent pipe leads to canister
Filler neck vent

## LG.8 - EVAPORATIVE EMISSION CONTROL SYSTEM (EECS) - Catalyst Cars Only

In the USA and certain other markets, no fuel vapour from the fuel tank venting system must be allowed to escape to atmosphere. The Evaporative Emission Control System (EECS) uses an activated carbon (charcoal) canister to absorb fuel vapours from the fuel tank breather when the vehicle is not operating. Under certain engine running conditions, the fuel vapour is purged from the charcoal by a flow of fresh air through the unit, with the air/vapour being drawn into the intake plenum and consumed in the normal combustion process. The charcoal is then prepared for optimum absorption of vapour when the engine is next stopped.

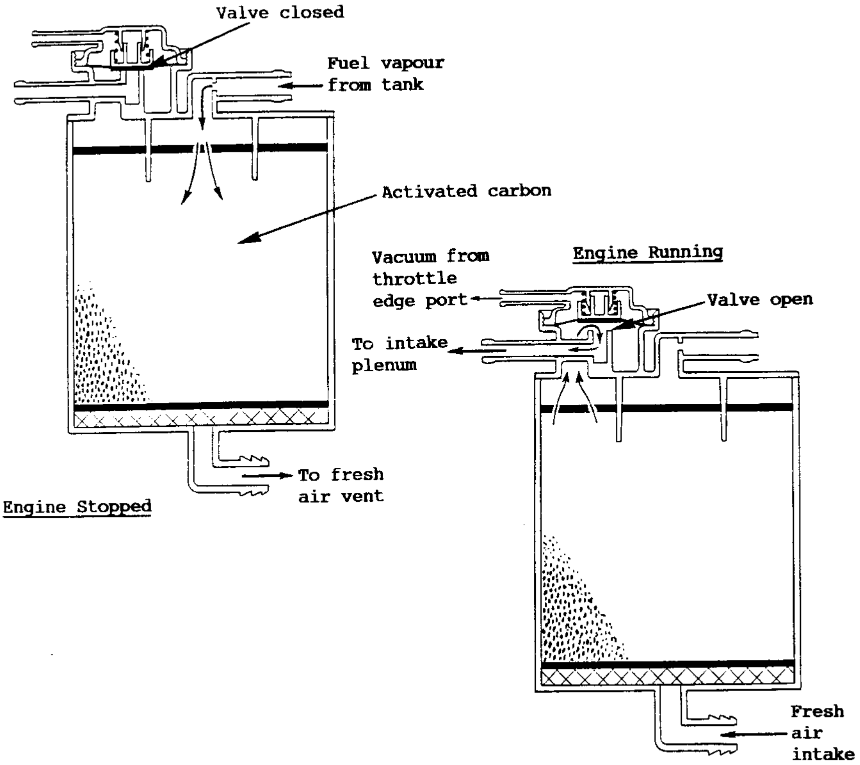
### Vapour Canister

This cylindrical canister is located behind the left hand door 'B' post and is provided with vapour, purge, and signal ports in its top surface. The breather pipe from the fuel tank filler neck is routed via a roll over valve located behind the filler neck (to prevent fuel draining if the car is inverted), to the canister vapour port. Ambient air enters the canister through a port in the bottom of the unit, and mixes with the vapour before being drawn through the purge control valve and an in-line restrictor and non return valve into the intake plenum.

### Control System

A purge control valve, mounted on top of, and integral with the canister, contains a diaphragm valve to regulate the amount of purging that takes place dependent on intake system pressures.

The spring loaded, normally closed diaphragm valve, controls the purge line


Valve closed
Fuel vapour from tank
Activated carbon
To fresh air vent
Engine Stopped
Vacuum from throttle edge port
Engine Running
Valve open
To intake plenum
Fresh air intake

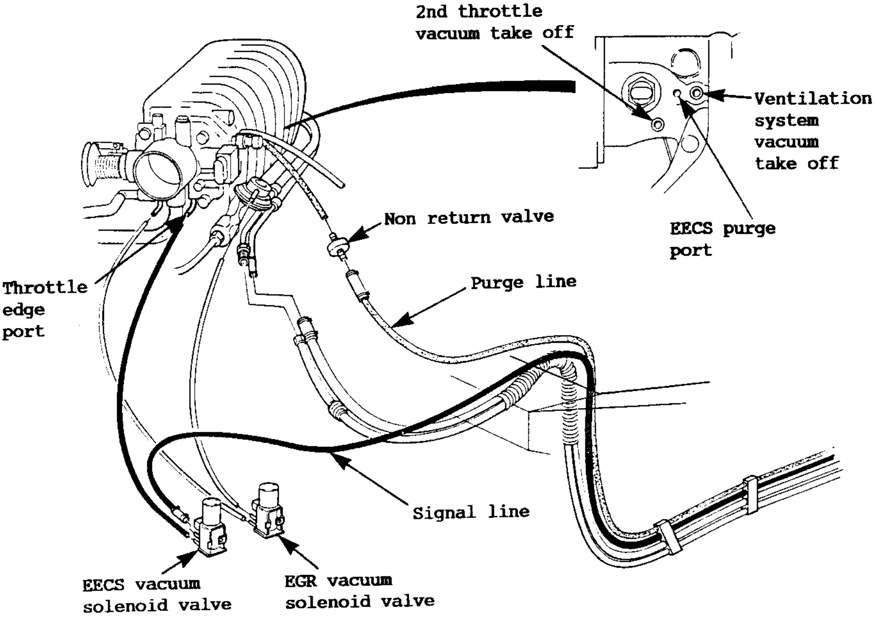
between the top of the canister and the intake plenum. The top side of the diaphragm is connected via a vacuum solenoid valve, to a primary throttle edge port. At part throttle, a vacuum signal is applied to this line and the diaphragm valve is opened, allowing the low pressure in the intake plenum chamber to draw fuel vapours from, and fresh air through, the canister element.

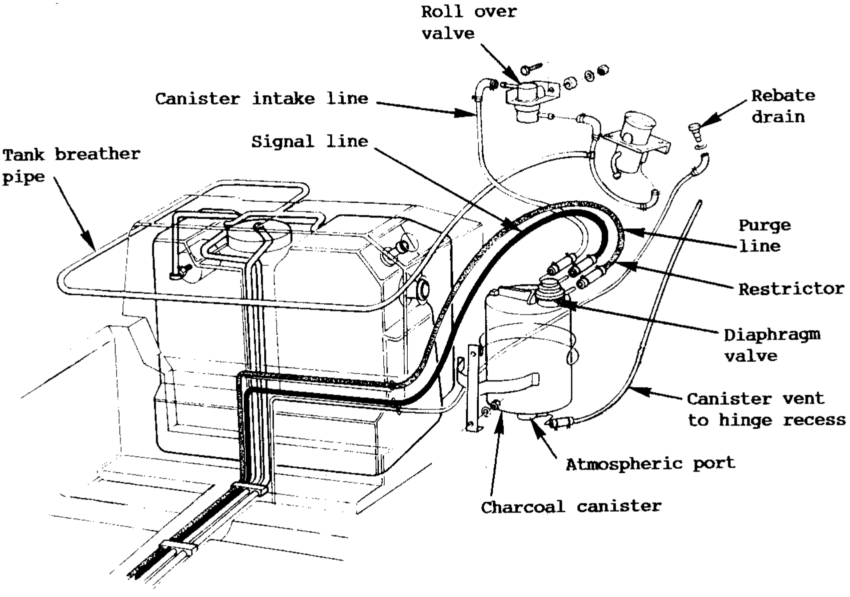
The solenoid valve, mounted on the left hand front wheelarch, and connected between the purge control valve and the throttle body, is controlled by the engine management E.C.M.. Under cold engine, or idle conditions, the solenoid is de-energised and shuts off the purge signal line, so that no purging takes place. The E.C.M. turns on the solenoid valve to permit purging when all the following conditions are met:

- above a specified coolant temperature;
- the engine has been running for a specified time period;
- above a specified road speed;
- above a specified throttle opening.

In addition, there must be sufficient vacuum at the throttle edge drilling to open the diaphragm valve.

A non-return valve fitted in the purge line between plenum and canister, prevents reverse flow when boost pressure is developed and plenum pressure becomes positive.


2nd throttle vacuum take off
Ventilation system vacuum take off
Non return valve
EECS purge port
Purge line
Throttle edge port
Signal line
EECS vacuum solenoid valve
EGR vacuum solenoid valve


Roll over valve
Canister intake line
Rebate drain
Signal line
Tank breather pipe
Purge line
Restrictor
Diaphragm valve
Canister vent to hinge recess
Atmospheric port
Charcoal canister

# MAINTENANCE & LUBRICATION

## ELAN & ELAN TURBO

| | Page |
|---|---|
| Recommended Lubricants | 2 |
| Maintenance Schedule | 3 |
| Pre-delivery Inspection | 7 |

## RECOMMENDED LUBRICANTS

**Engine**

In order to ensure the longevity and reliability of the vehicle, it is most important that only the specified lubricants are used. Adhere strictly to both the quality standard and viscosity rating, for the temperature range in which the vehicle will operate before the next service. The two most common oil quality classifications to be found labelled on oil containers, are API (American Petroleum Institute) and CCMC (Committee of Common Market Constructors). If neither of these classifications, with the specified standard is quoted, do not use.

| Manufacturer | SAE Viscosity Above -20°C | SAE Viscosity Below -20°C | API | CCMC |
|---|---|---|---|---|
| Preferred<br>Various | 10W/30 | 5W/30 | SF/CD or SG | G2 or G3 |
| Alternatives<br>Various | 15W/40 | 5W/30 | SF/CD or SG | G2 or G3 |
| Mobil 1<br>Rally Formula | 5W/50 | 5W/50 | SG | G3 |

| | |
|---|---|
| Oil change interval* - distance ) whichever - time ) sooner | 6,000 miles (10,000 km) or 12 months (NA), 6 months (Turbo) |
| Filter change interval* - N.A. | At 6,000 miles then every 12,000 miles (20,000 km) or 12 months |
| - Turbo | 6,000 miles (10,000 km) or 6 months |

* In severe service conditions (dusty areas, or cold, stop/start driving), change twice as frequently.

| | |
|---|---|
| Capacity - refill including filter | 3.5 litre (6.2 imp.pt; 3.7 US qt) |
| - refill without filter change | 3.3 litre (5.8 imp.pt; 3.5 US qt) |

**Transmission** (Gearbox & Final Drive Assembly)

| | |
|---|---|
| Only approved product | Mobil 1 RTS 9775 Fully Synthetic Motor Oil |
| Viscosity | SAE 5W/30 |
| Lotus part number | A100F6036V |
| Oil change interval | 30,000 miles (50,000 km) |
| Capacity - dry | 1.9 litre (3.35 imp.pt; 2.0 US qt) |
| - refill | 1.8 litre (3.2 imp.pt; 1.9 US qt) |

**Steering**

| | |
|---|---|
| Only approved product | Nippon Oils 'Besco A.T.F. Dexron' |
| Lotus part number | A100E6088V |

**Rear Hubs**

| | |
|---|---|
| Lubricant type | Lithium complex grease |
| Consistency | NLGI No.2 |

**Brake System**

| | |
|---|---|
| Hydraulic fluid | DOT 3 or DOT 4 |

**Engine Coolant Additive**

| | |
|---|---|
| Type | Ethylene Glycol blend |
| Concentration - recommended | 40% |
| - minimum | 25% |
| - max (severe climates) | 60% |
| Quantity (at 40% concentration) | 2.5 litre (4.4 imp.pt; 2.6 US qt) |

## MAINTENANCE SCHEDULE - ELAN & ELAN S.E.

LSL 271B

Date .......... Owner's Name ....................... Vehicle .............

Vehicle Registration No. ............ V.I.N. ...............................

Recorded Mileage .................... Service Reqd. ....... Job No. .........

An 'X' in the columns below means that the service operation is to be performed. Circle the Ⓧ when the operation has been performed satisfactorily.

Note
**'Inspect'** means assess condition and test for correct operation. Extra time is required to adjust or repair - advise customer beforehand if necessary.
**'Check'** means test and adjust/fill or tighten as necessary.

| **Distance covered (miles)** | **Service required** | **Distance covered (kilometers)** | |
|---|---|---|---|
| 6,000 m | A | 10,000 km | |
| 12,000 m | B | 20,000 km | |
| 18,000 m | A | 30,000 km | |
| 24,000 m | B | 40,000 km | |
| 30,000 m | A + C | 50,000 km | |
| 36,000 m | B | 60,000 km | |
| 42,000 m | A | 70,000 km | |
| 48,000 m | B | 80,000 km | |
| 54,000 m | A | 90,000 km | |
| 60,000 m | B + C # | 100,000 km | # plus extra items |
| 66,000 m | A | 110,000 km | |
| 72,000 m | B | 120,000 km | |
| 78,000 m | A | 130,000 km | |
| 84,000 m | B | 140,000 km | |
| 90,000 m | A + C | 150,000 km | |
| 96,000 m | B | 160,000 km | |

| OPERATION | Maximum time period (months) | SERVICE A | SERVICE B | SERVICE C | Other- miles (km) |
|---|---|---|---|---|---|
| **Fit protective covers to seats, footwells, steering wheel, & front wings.** | | X | X | | |
| **Lubrication** | | | | | |
| Renew engine oil* - N/A | 12 | X | X | | |
| - Turbo | 6 | X | X | | |
| Renew engine oil filter* - N/A (also at first 6,000m) | 12 | | X | | |
| - Turbo | 6 | X | X | | |
| Inspect engine & transmission for oil leaks | | X | X | | |
| Renew transmission oil | | | | X | |
| Repack rear wheel bearings | | | | X | |
| Check PAS fluid level | 6 | X | X | | |
| Renew PAS fluid | 24 | | | X | |
| * In 'severe service' conditions (dusty areas, or cold, stop/start driving), change twice as frequently or as required. | | | | | |
| **Engine** | | | | | |
| Renew air cleaner element* | | | | X | |
| Check coolant level & anti-freeze concentration | 6 | X | X | | |
| Renew coolant | 24 | | | X | |
| Check cooling system hoses & connections at pressure. | 12 | | X | | |
| Inspect radiator, oil cooler, chargecooler & pipework for damage or leaks. Clean all radiator finning | 12 | | X | | |
| Renew spark plugs** | | | | X | |
| **For peak engine performance the spark plugs can be replaced every 12,000 miles. However, plug changes at 30,000 miles will not affect or invalidate the emission performance of the engine. | | | | | |
| Replace timing belt | | | | | #60(100) |
| Check 'V' belt condition & tension | 24 | | | X | |
| Check CO level (cars without catalyst) | | | X | | |
| Inspect fuel pipes & connections with engine running. | 6 | X | X | | |
| Renew fuel filter | | | | | #60(100) |
| Inspect exhaust system & connections, engine running. | | | X | | |
| **Braking System** | | | | | |
| Check brake fluid level | 6 | X | X | | |
| Renew brake fluid | 12 | | X | | |
| Inspect brake hoses and pipes | 6 | X | X | | |
| Inspect brake pad thickness | | X | X | | |
| Check parking brake adjustment | | X | X | | |
| Inspect operation of brake tell tales | | X | X | | |
| **Clutch** | | | | | |
| Check operation & cable adjustment | | X | X | | |

Continued.......

| OPERATION (Continued) | Time | A | B | C | Other |
|---|---|---|---|---|---|
| **Steering & Suspension** | | | | | |
| Check security of steering column u/j clamps ........ | | | X | | |
| Inspect PAS pipes & hoses .......................... | 12 | | X | | |
| Inspect steering ball joints & gaiters ............. | | | X | | |
| Inspect condition of all suspension bushes .......... | | | X | | |
| Check security of front & rear suspension ........... | | X | X | | |
| Inspect dampers for leaks & performance ............. | | | X | | |
| Inspect front wheel bearings for play ............... | | | X | | |
| Check rear wheel bearings ........................... | | | X | | |
| Inspect front & rear wheel geometry ................. | | | X | | |
| Inspect condition of driveshaft gaiters ............. | 6 | X | X | | |
| **Wheels & Tyres** | | | | | |
| Inspect tyre condition & set pressures (inc spare) .. | 6 | X | X | | |
| Check wheel balance ................................. | | | | X | |
| Check wheel nut torque .............................. | | X | X | | |
| **Electrical** | | | | | |
| Inspect battery hydrometer (built in) ............... | 12 | | X | | |
| Check battery terminals for security & condition .... | 12 | | X | | |
| Inspect operation of all lights ..................... | 6 | X | X | | |
| Check headlamp alignment ............................ | | X | X | | |
| Inspect operation of all electrical equipment ....... | 6 | X | X | | |
| **Body** | | | | | |
| Check adjustment of all latches and hinges .......... | | | X | | |
| Inspect operation of CDL system ..................... | | X | X | | |
| Inspect operation & condition of seat belts ......... | | X | X | | |
| Inspect operation of heater/air conditioning ........ | | | X | | |
| Top up screenwash reservoir ......................... | | X | X | | |
| **Chassis** | | | | | |
| Inspect polyester coating for damage ................ | 12 | | X | | |

**Road Test Performance**

Engine performance .................... Brake performance ..................

Clutch operation ...................... Gearbox operation ..................

Steering performance .................. Wheel balance ......................

Driveline noise/vibration ............. Light operation ....................

Suspension noises ..................... Tyre condition .....................

General comments ..........................................................

Work completed by ..................... Dealer stamp:

Date ...............

**BLANK PAGE**

## PRE-DELIVERY INSPECTION - ELAN

LSL 273B

VIN.............................. Engine No..........................

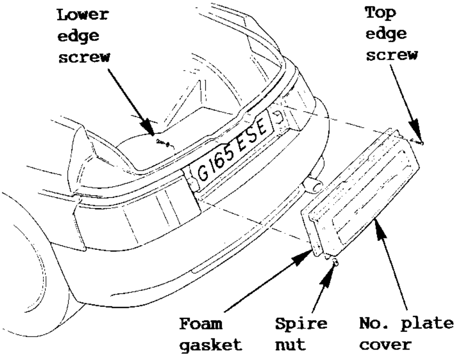
Fit protective covers to seats, footwells and steering wheel before commencing work.

| OPERATION | Tick if satisfactory<br>X if work required & submit warranty claim | Technician's initials |
|---|---|---|
| **Engine Bay** | | |
| Check engine & transmission oil levels | ... | ..... |
| Check security of engine oil filter | ... | ..... |
| Check coolant level | ... | ..... |
| Check brake fluid reservoir level | ... | ..... |
| Check clutch adjustment | ... | ..... |
| Check power steering fluid level (if fitted) | ... | ..... |
| **Start engine:** | | |
| Check cooling system for leaks | ... | ..... |
| Check engine & transmission for oil leaks | ... | ..... |
| Check fuel system for leaks | ... | ..... |
| Check power steering system for leaks (if fitted) | ... | ..... |
| Use 'Tech 1' tool to check data list & for stored trouble codes | ... | ..... |
| **Fuel Tank** | | |
| Completely fill fuel tank & check for leaks | ... | ..... |
| **Wheels & Tyres** | | |
| Check torque of wheel bolts | ... | ..... |
| Check tyre pressures inc. spare | ... | ..... |
| **Electrical** | | |
| Check security of battery terminals | ... | ..... |
| Check operation of all exterior & interior lamps | ... | ..... |
| Check operation of headlamp pod delay | ... | ..... |
| Check headlamp alignment | ... | ..... |
| Check operation of horns & hazard switch | ... | ..... |
| Check wiper operation in all modes & park position | ... | ..... |
| Check operation of windscreen washers & reservoir level | ... | ..... |
| Check operation of all instruments | ... | ..... |
| Check operation of door windows | ... | ..... |
| Check operation of heater/air conditioning & blower fan | ... | ..... |
| Check operation of door mirror controls & heaters | ... | ..... |
| Check operation of audio equipment | ... | ..... |
| **Body** | | |
| Check operation of doors, door locks & central locking | ... | ..... |
| Check bonnet and roof stowage lid release mechanism | ... | ..... |
| Check soft top roof erection & stowage | ... | ..... |
| Check interior trim for damage & cleanliness | ... | ..... |
| Check operation of seat belts | ... | ..... |
| Check all paintwork for damage | ... | ..... |
| Check presence of toolkit, jack & literature pack | ... | ..... |

Fit Number Plates

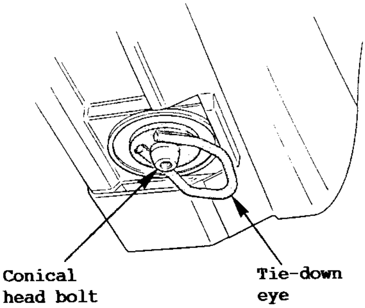
Front: A pair of mounting plinths (M6 thread) are provided on the front bumper.

Rear: Remove the number plate cover by releasing the 4 screws along the top edge from the outside, and the 4 lower edge screws from inside the boot.
Use double sided tape to secure the number plate to the rear transom, and refit the cover and gasket.



Remove Tie-Down Eyes

If the vehicle has been fitted with tie-down eyes at the body jacking points for transportation purposes, these should be removed prior to sale, and the tie-down eyes returned to Lotus Cars:
- Release the conical head bolt at the jacking point, remove the tie-down eye, and refit the bolt, torque tightening to 48 - 50 Nm (35 - 37 lbf.ft).



Road Test

Road test the vehicle and carry out further rectification work if necessary.

The pre-delivery inspection is subject to the following conditions:

a) It is the responsibility of the supplying distributor/importer/dealer to ensure that the car is delivered to the customer in the best possible condition.

b) All costs incurred during the inspection are the responsibility of the supplying distributor/importer/dealer.

c) Failure to return a signed copy of this inspection to Lotus Cars Ltd. by the distributor/importer/dealer, may result in warranty claims on the particular car being rejected.

Dealer signature ..............................

Date ........... Dealer stamp:

MAR 1990

# HEATING VENTILATION & AIR CONDITIONING

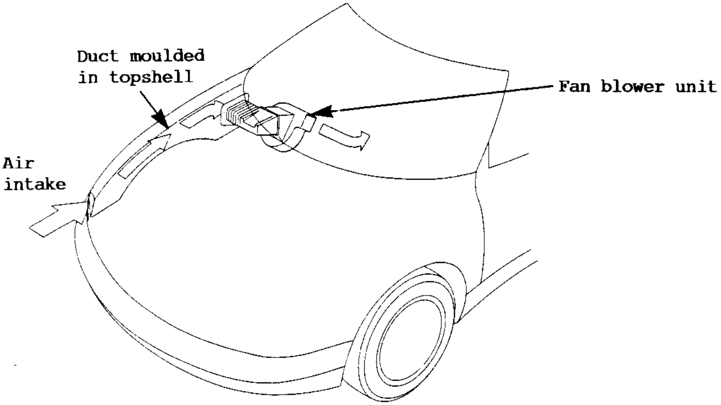
## SECTION PE - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | PE.1 | 2 |
| Climate Controls & Airflow Distribution | PE.2 | 6 |
| Vacuum Pipework & Switching Logic | PE.3 | 14b |
| Refrigerant Handling | PE.4 | 16 |
| Refrigerant Pipework Precautions | PE.5 | 16 |
| Evacuation & Charging Procedure | PE.6 | 17 |
| Refrigerant Oil | PE.7 | 18 |
| Compressor | PE.8 | 20 |
| Climate Control Switches | PE.9 | 20 |
| Air Intake/Blower Assembly | PE.10 | 22 |
| Evaporator Assembly | PE.11 | 23 |
| Heater/Distribution Unit | PE.12 | 25 |

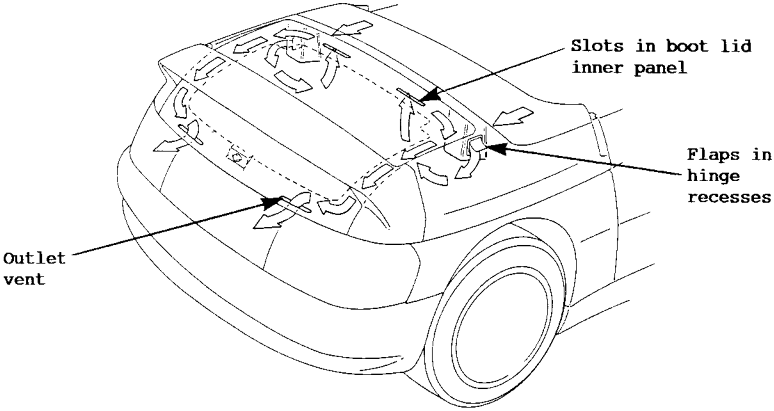
## PE.1 - GENERAL DESCRIPTION

### Ventilation

The ventilation system uses an air intake duct which collects air from the gap between the front bumper and front topshell, and runs inside the top of the passenger side front wheelarch before passing through the front bulkhead into the blower motor housing. On air conditioned cars, an air intake flap within this housing admits either fresh air from the intake duct, or 're-circulated' air from the cabin interior. The four speed blower fan forces air through the air conditioning evaporator (if fitted), and into an air blend heater unit which shares a housing with the distribution chamber. Two vacuum operated distribution flaps within this unit direct air to the various outlet vents.



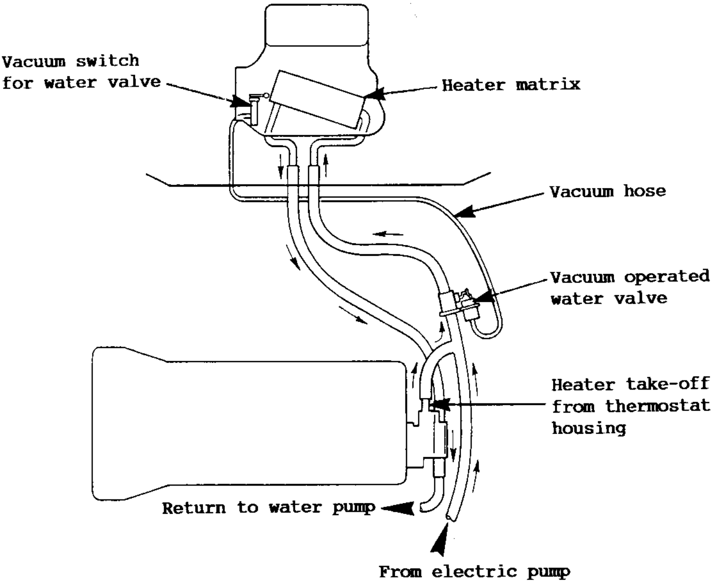
When the soft top roof is raised, air is able to vent from the cabin interior via one way flap valves in the rear bulkhead hinge recesses, into the boot. Ventilation of the boot is achieved by ducting air through the boot lid reinforcing channels to outlets over the rear number plate. Care should be taken not to obstruct the ventilation system with luggage or clothing.



Heating

The heater system uses a heater matrix (heat exchanger) housed within the air distribution chamber beneath the fascia, and fed with engine coolant, to heat the incoming air blown through it by the blower fan. The water feed to the heater matrix is taken from the thermostat housing at the left hand end of the engine, with the return hose connecting to the radiator by-pass pipe. The supply of coolant to the matrix is controlled by a vacuum operated water valve in the supply line, and located in the engine bay. The valve is operated by vacuum micro-switch located on the underside of the heater/distribution unit, and is shut off only when the full cold setting is selected. At all other times the valve is open, and the heater matrix hot, with the temperature of air from the outlet vents controlled by the proportion of air directed through the matrix.

Air flow through the heater matrix is managed by two interlinked air mixer flaps which are controlled by a link rod from the temperature selection rotary control, to the underside of the heater housing.

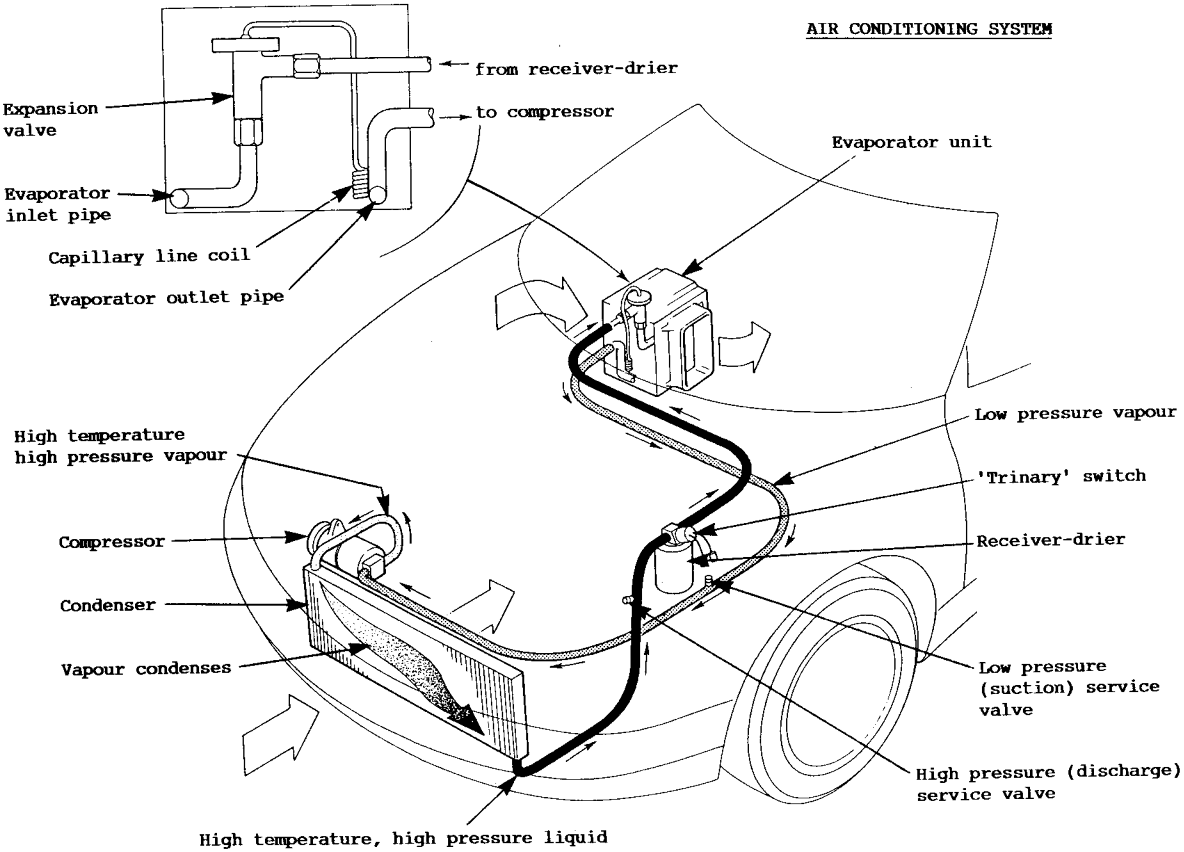

**Vacuum switch for water valve**
**Heater matrix**
**Vacuum hose**
**Vacuum operated water valve**
**Heater take-off from thermostat housing**
**Return to water pump**
**From electric pump**

Air Conditioning (if fitted)

The air conditioning unit uses a cycling clutch system with a thermostatic expansion valve to provide refrigerated air to the vehicle interior. The system comprises:

- a closed circuit containing refrigerant 'R12';
- a compressor mounted on the front side of the engine driven by multi-vee belt from the front end of the crankshaft via an electromagnetic clutch;
- a condenser mounted immediately ahead of the engine cooling radiator;
- a receiver-dehydrator mounted at the left hand side of the engine bay;
- a thermostatic expansion valve fitted at the inlet connection to -
- an evaporator unit fitted beneath the fascia, between the blower unit and heater/distribution unit.

## AIR CONDITIONING SYSTEM


from receiver-drier
to compressor
Expansion valve
Evaporator inlet pipe
Capillary line coil
Evaporator outlet pipe
Evaporator unit
Low pressure vapour
'Trinary' switch
Receiver-drier
Low pressure (suction) service valve
High pressure (discharge) service valve
High temperature high pressure vapour
Compressor
Condenser
Vapour condenses
High temperature, high pressure liquid

**Closed Circuit**

The closed refrigerant circuit should not be opened unless absolutely necessary, and only after referring to section PE.5 - 'Refrigerant Handling Precautions'. Failure to observe these precautions may result in personal injury.

**Compressor**

When the engine is running, and the air conditioning is selected, the electromagnetic clutch incorporated in the compressor pulley is energised, which then locks the pulley to the shaft and drives the compressor. A thermostatic switch senses the temperature of air cooled by the evaporator, and cycles the clutch on/off to maintain air temperature just above freezing, to provide optimum cooling without the possibility of ice forming on the evaporator core. The thermostatic switch is mounted on the underside of the outlet end of the evaporator casing, with its capillary tube (temperature sensor) inserted into the evaporator matrix.

When the compressor is running, an additional load is placed on the engine, and to avoid stalling and maintain idle speed, a signal is sent to the engine management ECM which opens the idle air control valve accordingly.

The compressor is lubricated by a quantity of special refrigerant oil which is added to the refrigerant. Some of the oil is retained in the compressor with the remainder being circulated with the refigerant.

The compressor discharges high temperature, high pressure refrigerant vapour into the condenser.

**Condenser**

The condenser, located immediately ahead of the engine cooling radiator, is of labyrinthine construction, and is made from aluminium for good thermal conductivity. The hot vapour flowing through the condenser releases heat to the cooling airflow passing over the condenser finning through the forward motion of car, or induced by the two electric fans fitted behind the engine cooling radiator. These fans are cycled on/off according to refigerant pressure (as well as engine coolant temperature), as sensed by a switch at the receiver-drier.

The hot vapour condenses into a high temperature, high pressure liquid, before flowing into the receiver-drier.

**Receiver-Drier**

The receiver-drier is mounted at the left hand side of the engine bay, and serves as a reservoir for storage of high pressure liquid produced in the condenser and incorporates a screen sack filled with desiccant to absorb traces of moisture and other contaminants. A sight glass built into the top of the receiver-drier enables a quick check of the amount of refrigerant charged in the system. If the refrigerant charge is low, a stream of bubbles will be visible at the sight glass. Note: A clear site glass, while indicating that the system has the correct charge, can also indicate complete absence of refrigerant. This situation is usually accompanied by oil streaks.

A 'trinary' switch senses the pressure of refrigerant leaving the compressor, and:

- switches on the radiator cooling fans above a certain pressure;
- switches off the compressor if excessive pressure is detected (protects system from further damage in case of a control system failure);
- switches off the compressor if an excessively low pressure is detected, to protect the compressor from oil starvation in the event of a system de-pressurisation.

**Expansion Valve**

The expansion valve is fitted into the high pressure line at the intake to the evaporator, and is contained within the evaporator casing. The expansion valve provides a restriction to the flow of high pressure liquid into the evaporator, such that as it flows through the valve, it undergoes a pressure drop which causes a change of state from a high temperature, high pressure liquid, to a low pressure, low temperature atomised liquid. This then enters the evaporator, where due to the low pressure, the atomised liquid starts to boil (evaporate), and in so doing, draws the necessary heat for this process from the warm air stream passing over the evaporator surface. The airstream is thus cooled, and is then directed through the various outlet vents into the passenger compartment.

The flow of refrigerant through the evaporator is thermostatically controlled by the expansion valve, which uses a capillary line strapped to the evaporator outlet pipe to sense outlet temperature. Valve valve opening is modulated to provide optimum cooling performance.

**Evaporator**

The evaporator is contained in a housing which fits beneath the fascia between the blower motor and the heater/distribution unit. All the airflow passes through the evaporator, whether or not the a/c is operating. The expansion valve is attached to the evaporator inlet connection, and is contained within the evaporator casing. The inlet and outlet pipes project through the bulkhead into the engine bay, where pipework connects to the inlet from the receiver-drier unit, and from the outlet to the compressor suction port, where the low pressure vapour is compressed and commences another cycle.

## PE.2 - CLIMATE CONTROLS & AIRFLOW DISTRIBUTION

The interior climate controls are located in the centre console, and comprise two rotary controls for heater temperature and air distribution, and a horizontal slider for fan speed. Cars with air conditioning have an additional rocker switch controlling this function, located at the bottom of the centre console. The engine must be running for either the heater or air conditioning to operate.

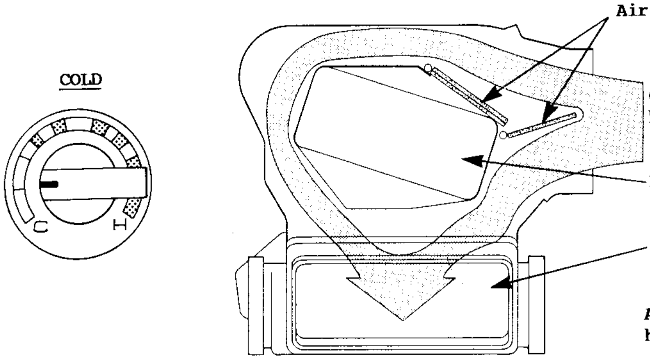
### Fan Speed Control

Fan speed is controlled by a horizontal slider between the two rotary controls. With the lever fully to the left, the fan is switched off, and only minimal airflow will be obtained from the vents. Moving the slider to the right, provides four increasing fan speeds to boost air circulation. The fan speed resistor block is fitted in the fan motor housing, where it is cooled by the airflow.

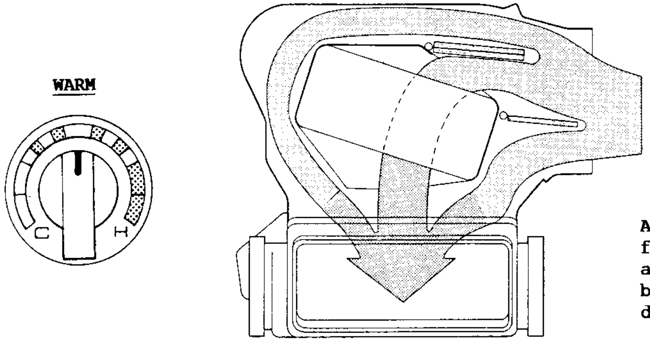
### Heater Temperature

The heater temperature control is the lower of the two rotary controls in the centre console. The rotary movement of the knob is converted, via a pinion and quadrant, to a linear movement of a link rod which connects with the air mixer flaps on the underside of the heater housing. Airflow through the heater housing is controlled by two interlinked flaps which control the proportion of air which is directed through, or around the heater matrix.

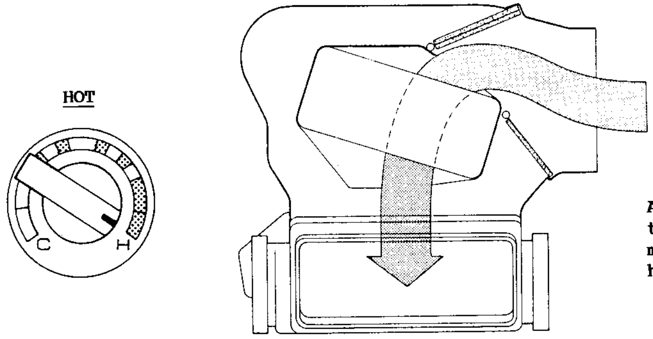
For ambient (unheated) air, turn the control fully counterclockwise. This action causes the flaps to shut off the heater matrix, and direct all the airflow around the outside of the matrix to the distribution chamber. In addition, when the flaps are moved to the fully cold position, the flap operating lever opens a vacuum micro-switch mounted on the bottom of the heater housing, and supplies


COLD
C
H
Air mixer flaps
Cold air from blower motor
Heater matrix
Air distribution chamber

All airflow by-passes heater matrix



Airflow divided to flow both through and around heater matrix before blending in distribution chamber



All air directed through heater matrix for full heat vacuum to close a nomally open water valve in the engine bay.

As the temperature control is turned clockwise, the micro-switch is opened and ventilated, allowing the water valve to open and supply hot water to the heater matrix. As the control is turned further, an increasing proportion of the airflow is directed through the heater matrix, resulting in a progressive increase in the temperature of air supplied to the interior. With the control turned fully clockwise, all the air is directed to flow through the heater matrix for maximum air temperature.

### Air Re-circulation

**Cars with 4-position distribution control.**

Air re-circulation is available only on air conditioned vehicles. On these cars, a vacuum micro-switch fitted on the top of the heater housing, controls a vacuum actuator on the air intake housing. When the temperature control is turned to the fully cold position, a cam on the top end of one of the heater flap spindles, releases (closes) the vacuum micro-switch. In this position, no vacuum is applied to the intake flap actuator, which holds the flap in re-circulation mode, with the re-circ. port open and the fresh air intake closed. When the temperature control is moved off the fully cold position, the cam opens the micro-switch, and allows vacuum to flow through the valve to the intake flap actuator, which opens the fresh air intake, and closes the re-circ. port.

On a.c. cars therefore, when the temperature control is turned to fully cold, re-circulation is automatically obtained. For fresh air, the control must be turned to a position just off the fully cold stop to open the fresh air intake, which should operate before further turning of the control opens the water valve.

Note that the intake flap microswitch is also fitted on heater cars, but the outlet port is blanked off. The blower fan unit is not fitted with an intake flap, and has the recirculation aperture blanked off.

**Cars with 6-position distribution control.**

On these cars (inc. all USA vehicles), a re-circulation position is provided on the distribution control for both heater and a.c. vehicles. See below.

### Air Distribution

The air distribution control is the upper of the two rotary controls in the centre console. The control is a rotary vacuum switching valve, which supplies vacuum to various vacuum actuators which operate the distribution flaps. Vacuum is supplied (with the engine running) from a port on the rear of the primary throttle body, and is stored in a reservoir at the rear of the left hand front wheelarch. The intake port on the reservoir (LH of the two ports), is marked 'vacuum' and incorporates a non-return valve to retain a vacuum supply when the engine is stopped, or when long periods of wide open throttle are used (low intake vacuum). A supply line from the reservoir RH port leads to the distribution control, and to the water valve vacuum micro-switch on the underside of the heater unit.

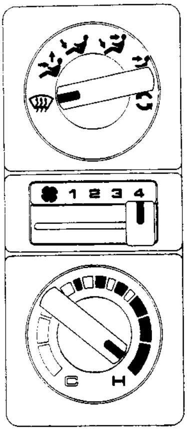
The distribution control supplies vacuum to a two stage vacuum actuator controlling the face level vent flap, a single stage actuator controlling the footwell/screen flap, and the micro-switch for the intake flap (not used on heater cars with 4-position distribution controls).

All '90 and some '91 MY cars are fitted with 4-position control switches, whereas all USA models, and other cars as a running change, have 6-position controls. All control positions are marked by symbols, with detents provided to permit selection by 'feel'.

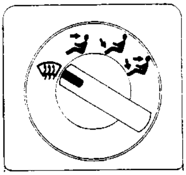
## Defrost

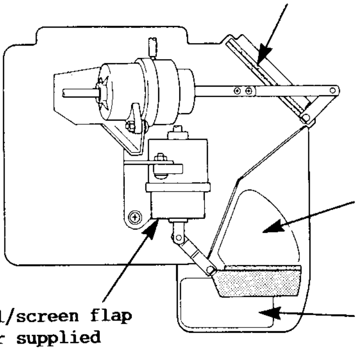
With the knob turned fully counterclockwise, airflow is directed to the windscreen. Vacuum is supplied to the footwell/screen flap actuator, which operates to open the screen vents and close off the footwells. The face level vents are closed off by the FLV flap. For optimum defrost performance, select maximum heat and fan speed.

6-Position

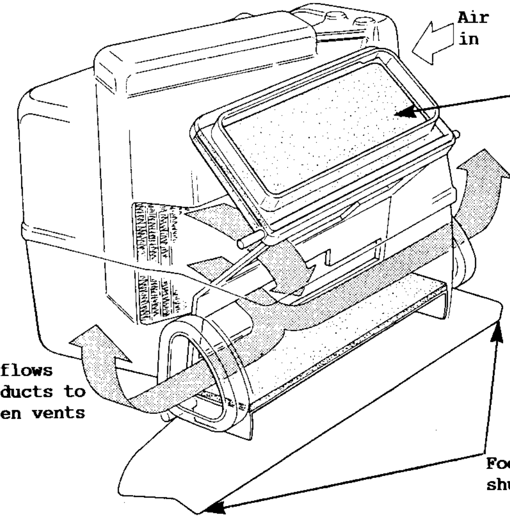


4-Position




Face level vents shut off
Screen vents open
Footwell/screen flap actuator supplied with vacuum
Footwell vents shut off

LHD system shown

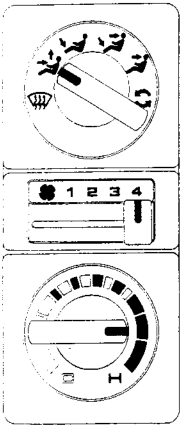

Air in
Face level vent outlet shut off
Air flows via ducts to screen vents
Air flows via ducts to screen vents
Footwell vents shut off

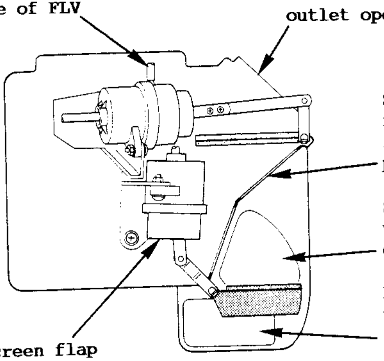
**Demist**

This feature is available only on cars with the 6-position distribution control, and allows for airflow to the screen to be maintained whilst also supplying air to the face level vents to help side window demisting.

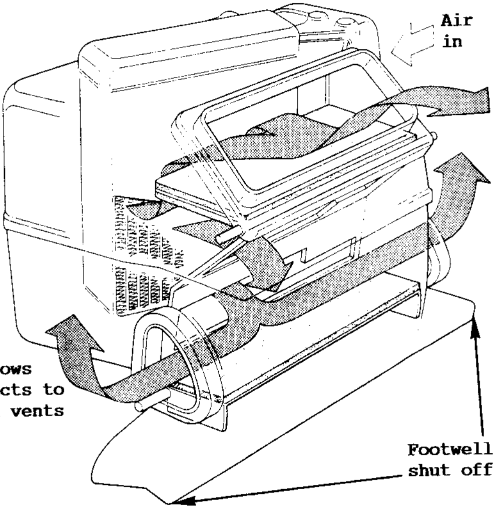
Vacuum is supplied to the footwell/screen flap actuator, which operates to open the screen vents and close off the footwells. Vacuum is also supplied to the first stage (end port) of the FLV actuator, which moves to a mid position so that air from the heater matrix is directed both to the windscreen, and to the face level vents. This position is normally used with a warm temperature setting, keeping the centre face level vents closed, and directing the side vents to demist the door windows.

**6-Position control only**




Vacuum supplied to 1st stage of FLV actuator
Face level vent outlet open
Screen/ footwell internal port open
Screen vents open
Footwell vents shut off
Footwell/screen flap actuator supplied with vacuum

LHD system shown

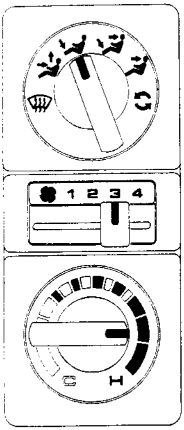

Air in
Air to face level vents
Air flows via ducts to screen vents
Air flows via ducts to screen vents
Footwell vents shut off

## Footwell

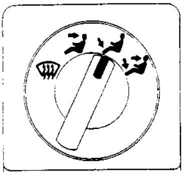
At this setting, the face level vents are shut off. Air flow is directed to the footwells, with a small amount to the screen for demisting.

No vacuum is supplied to either FLV or footwell/screen actuator, so that the FLV flap shuts off the face level vents, and the footwell/screen flap opens the footwell vents. Air flows through the footwell internal aperture to the footwell vents, with a small amount feeding into the screen vents to aid de-misting. Use with a warm temperature setting and fan speed as desired.

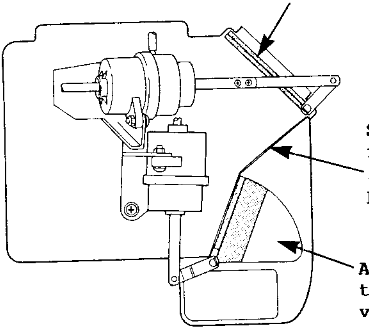
**6-Position**

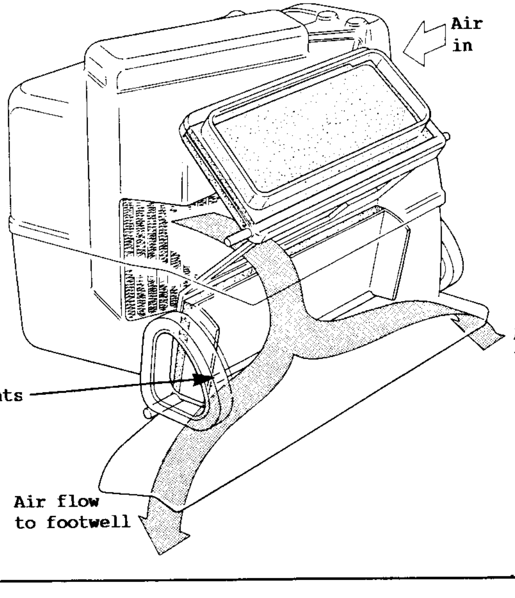


**4-Position**



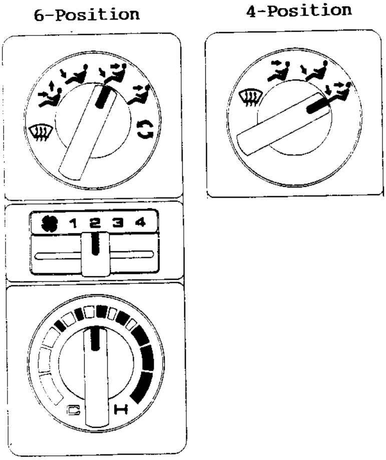
LHD system shown

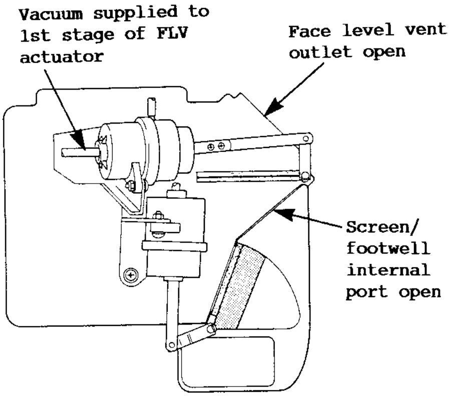

Face level vent outlet shut off
Screen/ footwell internal port open
Air bleed to screen vents


Air in
Air flow to footwell
Air bleed to screen vents
Air flow to footwell

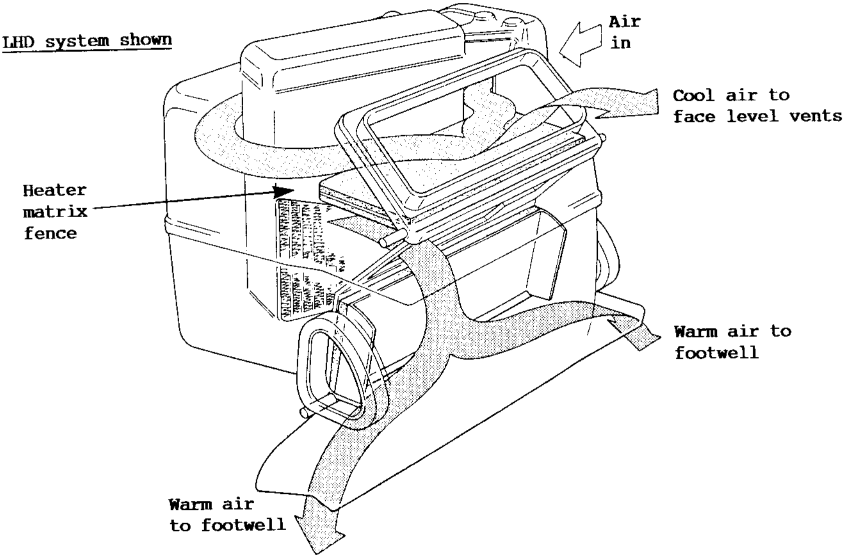
## Bi-Level

This position provides temperature stratification, so that cool air may be obtained through the face level vents, with warmer air provided to the footwells. Vacuum is supplied only to the first stage (end port) of the FLV actuator, which moves to a mid position, and aligns with a fence over the top part of the heater matrix. With a mid-position selected on the temperature control, warm air flowing through the heater matrix is directed through the footwell internal aperture to the footwell vents, whilst cooler air, which has by-passed the heater matrix, flows over the FLV flap to the face level vents.


6-Position
4-Position
1 2 3 4
C
H


Vacuum supplied to 1st stage of FLV actuator
Face level vent outlet open
Screen/ footwell internal port open

LHD system shown

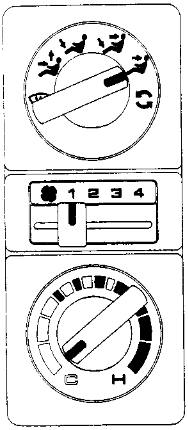

Air in
Cool air to face level vents
Heater matrix fence
Warm air to footwell
Warm air to footwell

**Face Level Vents**

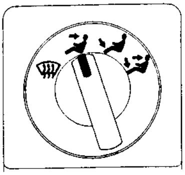
At this position, all air is directed to the four face level vents, each of which is provided with its own volume and direction controls (see later).

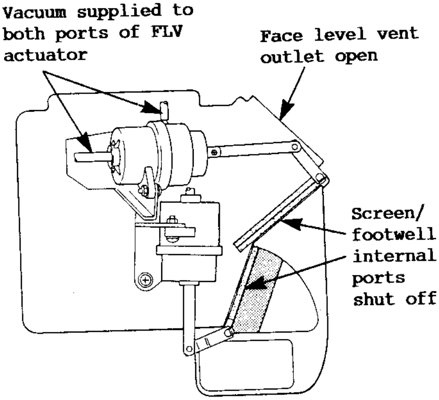
Vacuum is applied to both ports on the FLV actuator, which moves full travel to open the face level vent, and close off the footwell internal aperture. A delay valve fitted in line #5 between the rotary control and FLV actuator 2nd stage port (in the side of the actuator), ensures that the two stage actuator operates sequentially. The screen/footwell flap (no vacuum) closes off the screen and footwell vents so that all air is directed to the face level vents. Use this position with a cool temperature selection and fan speed as desired.

**6-Position**

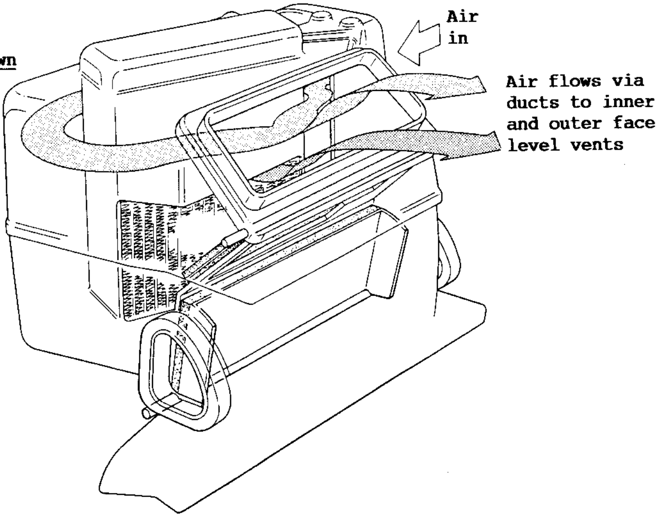


**4-Position**




Vacuum supplied to both ports of FLV actuator
Face level vent outlet open
Screen/ footwell internal ports shut off

**LHD system shown**

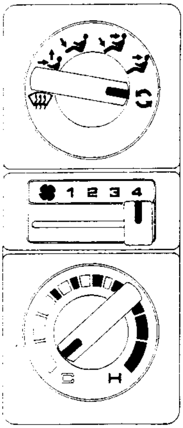

Air in
Air flows via ducts to inner and outer face level vents

**Recirculation**

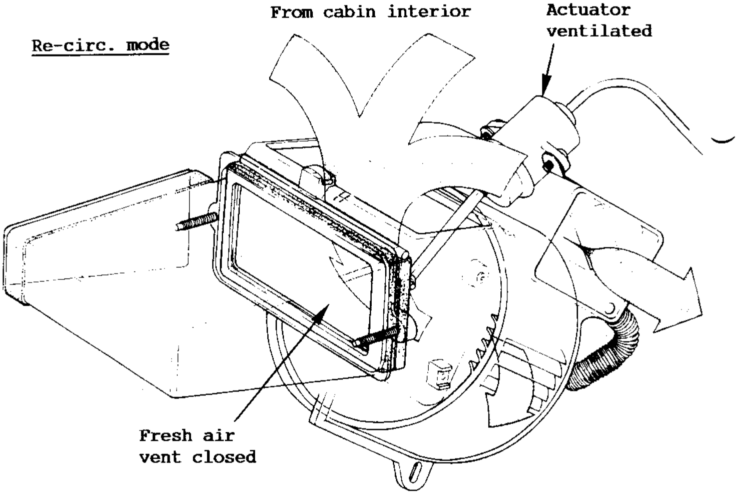
This position is applicable only to those vehicles fitted with the 6-position distribution control. For earlier cars (4-position) with air conditioning, a re-circ. facility is provided via the temperature control (see earlier).

At this setting, the distribution of air is as for the face level vent position, but the vacuum supply to the air intake flap actuator is cut off, allowing the flap to shut off fresh air port and open the recirculation port. When the fan is operating, air is continuously re-cycled within the car through the face level vents. This position should be used in conjunction with air conditioning (if fitted) for maximum cooling, or in heavy traffic to avoid drawing fumes into the car.

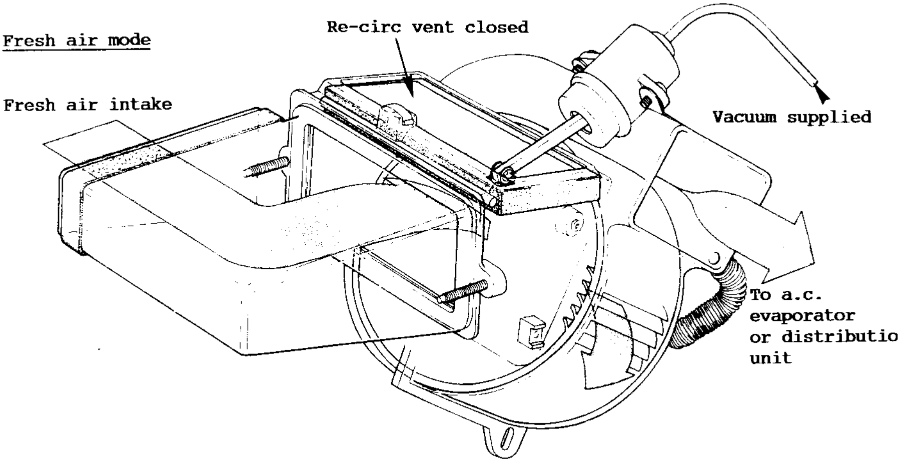
6-Position
control only



Re-circ. mode


From cabin interior
Actuator
ventilated
Fresh air
vent closed

Fresh air mode


Re-circ vent closed
Fresh air intake
Vacuum supplied
To a.c.
evaporator
or distributio
unit

Air Conditioning

Cars fitted with air conditioning, are provided with a rocker switch on the centre console, and an adjacent amber tell tale to indicate when the circuit is operating.

To select refrigerated air, press the rocker switch to activate the compressor, and position the heater temperature control at cold. Turn the distribution control to the face level vents position, open the vents, and for maximum cooling efficiency keep the roof up and the windows closed. Note that the slow fan speed will be activated automatically when the a/c rocker switch is pressed, but a faster speed may be selected if desired. On cars with 4-position distribution controls, if the temperature control is turned fully counterclockwise, the recirculation vent will be opened so that refrigerated air is continuously re-cycled within the car, but if the control is turned away from the fully cold stop, fresh air will be admitted. Cars with 6-position distribution controls, are provided with a recirculation position for maximum cooling, and a face level vents position for refrigerated fresh air.

De-Humidified Heating (cars with a.c.)

On cars fitted with air conditioning, de-humidified air may be obtained by using the air conditioning in conjunction with a warm temperature control setting. In this way, the air is first cooled to reduce its humidity, and then heated to the temperature required. Use this feature to help demist the windscreen and other windows.

Important Notes on Use of Air Conditioning

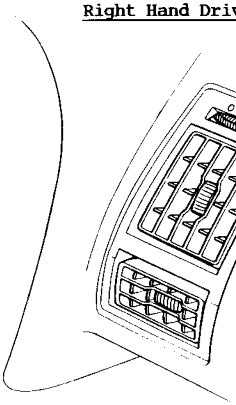
1. It is not recommended that the airflow from the face level vents be directed at persons during maximum refrigeration, as this can cause discomfort (e.g. cramp).
2. Under certain ambient conditions (especially high humidity) a white vapour may issue intermittently from the face level vents. This is quite normal and should cause no concern.
3. To ensure that the internal components of the air conditioning compressor are kept adequately lubricated, the air conditioning should be switched on for at least a few minutes every week to permit the oil to circulate.
4. Some extreme conditions of engine operation will override the a/c request signal and switch off the air conditioning. These include: wide open throttle to make available full engine power; high vehicle speed to increase engine cooling margins; abnormally high engine coolant temperature to help prevent overheating.
5. When air conditioning is selected, the radiator cooling fans will cycle on and off dependent on system pressures as sensed by the trinary switch at the receiver-drier, regardless of engine coolant temperature.

Face Level Vents

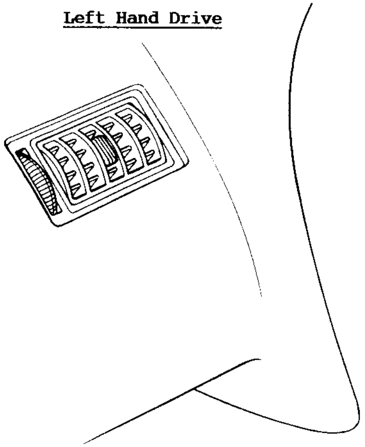
Four face level vents are fitted; two in the centre console, and one at each end of the fascia. The central vents, and on left hand drive cars, the outer vents, are fitted with a volume control thumbwheel, the turning of which opens or closes the vent, and a centre knob by which the direction of airflow may be aimed.

On right hand drive cars, each of the two outer vents comprises of separate upper and lower outlets, each with its own directional control knob. A thumbwheel above the vents enables the airflow from both upper and lower outlets to be shut off (O), or opens the lower vent only (▽), or opens both vents (△▽).

**Right Hand Drive**



**Left Hand Drive**



PE.3 - VACUUM PIPEWORK & SWITCHING LOGIC

The ports on the rotary distribution control are numbered. The switch distributes vacuum to the various ports as shown in the following table:

4-Position Distribution Control

| Control Position | Rotary Control Port Number 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Defrost | Yes | Supply | No | Yes | No |
| Face Level Vents | Yes | Supply | Yes | No | Yes |
| Footwell | Yes | Supply | No | No | No |
| Bi-Level | Yes | Supply | Yes | No | No |

Yes = vacuum supplied

No = port ventilated

The vacuum hoses from the distribution control are numbered according to the port to which they are connected.

**Hose #1;** Re-circ. switch supply. Runs from port #1 on the distribution control, to the top port on the re-circ. micro-switch mounted on top of the heater unit.

**Hose #2;** Distribution supply. Runs from the right hand port of the vacuum reservoir, through the front bulkhead to a 'T' piece. One branch runs to the downward facing port of the water valve microswitch on the underside of the heater housing. The other branch runs to port #2 of the distribution control switch.

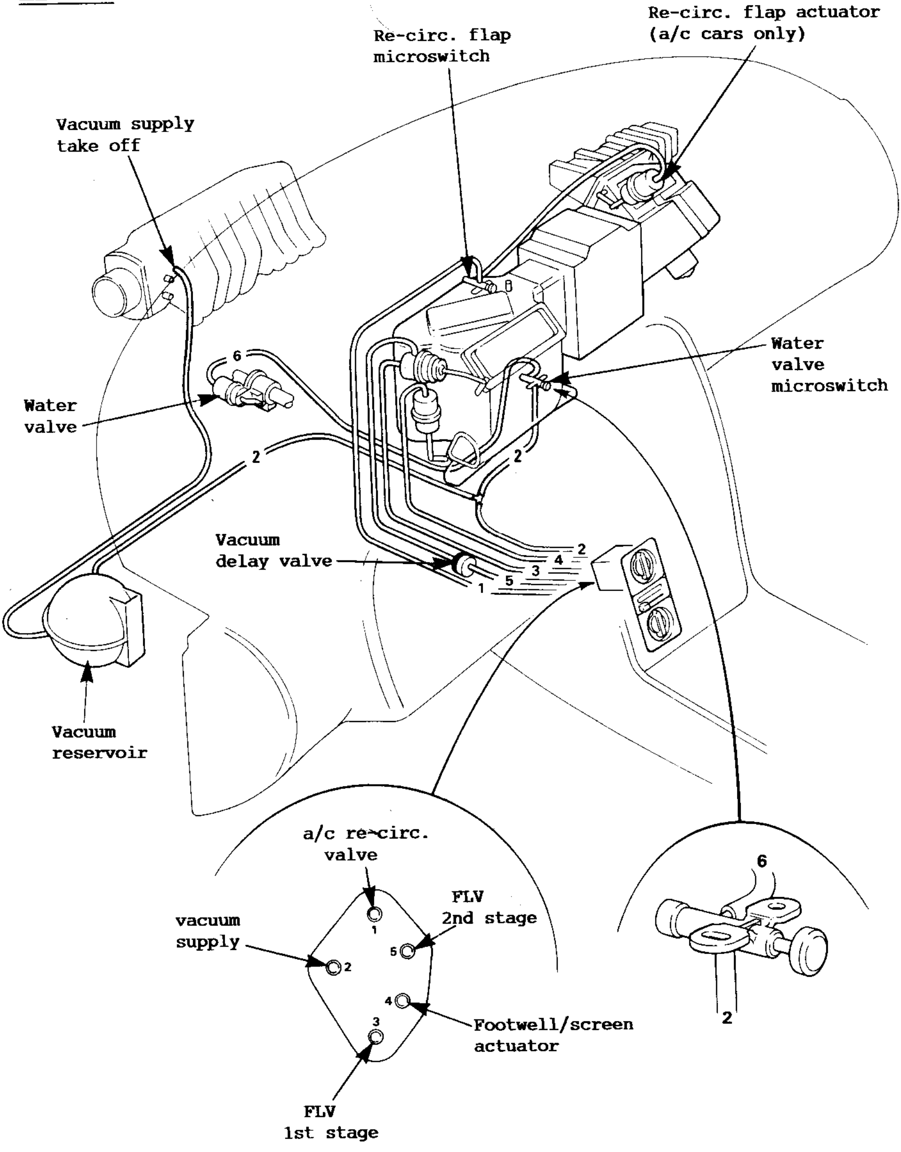
**Hose #3;** FLV 1st stage. Runs from port #3 of the distribution control, to the end port on the face level vent actuator.

**Hose #4;** Footwell/screen. Runs from port #4 of the distribution control, to the footwell/screen actuator.

**Hose #5;** FLV 2nd stage. Runs from port #5 of the distribution control, to the side port on the face level vent actuator. A delay valve is fitted in this line, (white side towards the control switch) to ensure that the FLV 1st stage always operates before the 2nd stage.

## Vacuum Connection Diagram: 4-position distribution control

LHD shown


Re-circ. flap actuator (a/c cars only)
Re-circ. flap microswitch
Vacuum supply take off
Water valve microswitch
6
Water valve
2
2
Vacuum delay valve
2
4
3
5
1
Vacuum reservoir
a/c re-circ. valve
FLV 2nd stage
vacuum supply
1
5
2
4
3
Footwell/screen actuator
FLV 1st stage
6
2

**Hose #6;** Water valve. Runs from the sideways facing port on the water valve microswitch, through the bulkhead, to the water valve at the rear of the engine bay.
Two further hoses complete the system:
- Reservoir supply; Runs from the vacuum take-off port on the rear of the primary throttle body, to the left hand port (marked 'vacuum') on the vacuum reservoir mounted at the rear of the left hand front wheelarch.
- Re-circ. actuator; Runs from the sideways facing port on the micro-switch on top of the heater housing, to the re-circ. flap actuator on the blower housing.

6-Position Distribution Control (inc. all USA cars)

| Control Position | Rotary Control Port Number | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Defrost | No | Supply | Yes | No | Yes |
| Demist | No | Supply | Yes | Yes | Yes |
| Footwell | No | Supply | No | No | Yes |
| Bi-Level | No | Supply | No | Yes | Yes |
| Face Level Vents | Yes | Supply | No | Yes | Yes |
| Recirculate | Yes | Supply | No | Yes | No |

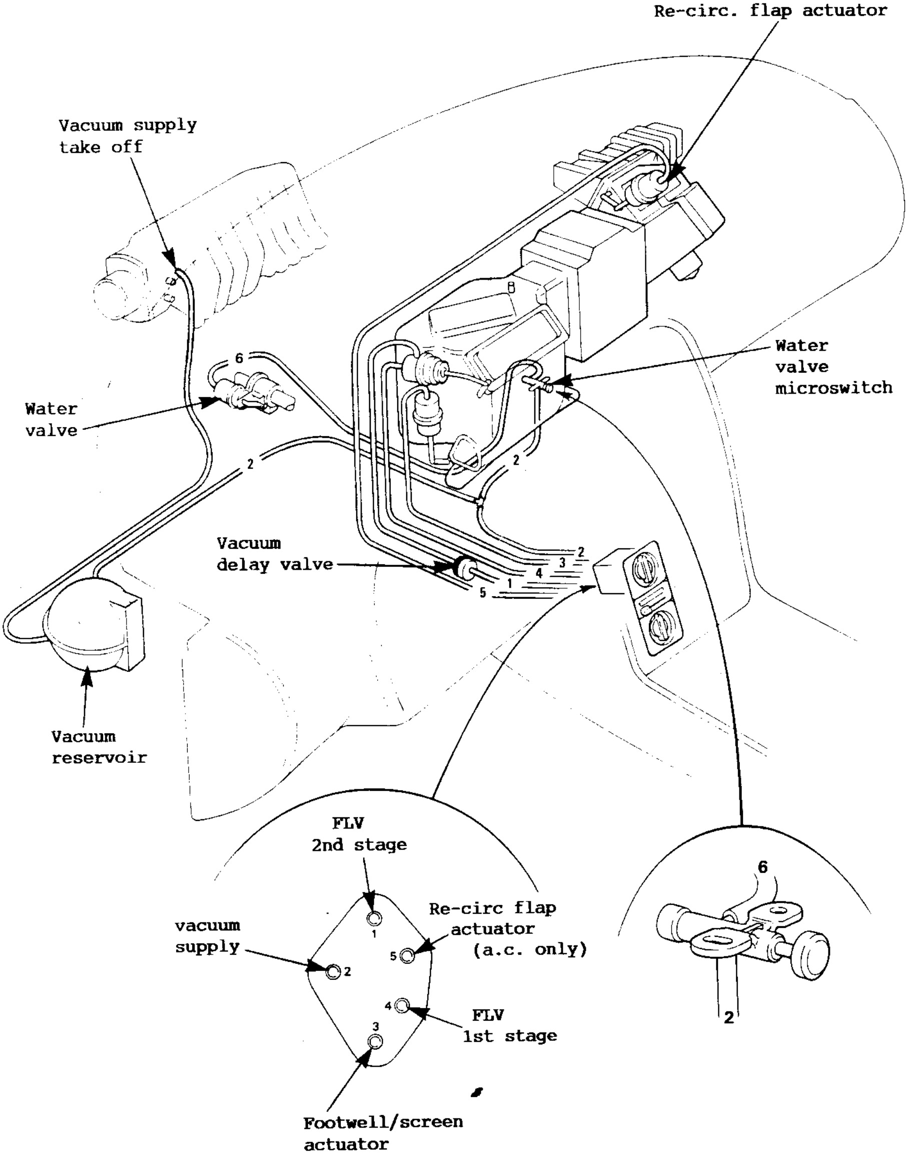
Yes = vacuum supplied

No = port ventilated

The vacuum hoses from the distribution control are numbered according to the port to which they are connected.
**Hose #1;** FLV 2nd. stage. Runs from port #1 of the distribution control, to the side port on the face level vent actuator. A delay valve is fitted in this line, (white side towards the control switch) to ensure that the FLV 1st stage always operates before the 2nd stage.
**Hose #2;** Distribution supply. Runs from the right hand port of the vacuum reservoir, through the front bulkhead to a 'T' piece. One branch runs to the downward facing port of the water valve microswitch on the underside of the heater housing. The other branch runs to port #2 of the distribution control switch.
**Hose #3;** Footwell/screen. Runs from port #3 of the distribution control, to the footwell/screen actuator.
**Hose #4;** FLV 1st stage. Runs from port #4 of the distribution control, to the end port on the face level vent actuator.
**Hose #5;** Recirculation. On a.c. cars runs from port #5 of the distribution control to the intake flap actuator on the blower fan unit. On heater cars, port #5 is blanked off.
**Hose #6;** Water valve. Runs from the sideways facing port on the water valve microswitch, through the bulkhead, to the water valve at the rear of the engine bay.
One further hose completes the system:
- Reservoir supply; Runs from the vacuum take-off port on the rear of the primary throttle body, to the left hand port (marked 'vacuum') on the vacuum reservoir mounted at the rear of the left hand front wheelarch.

## Vacuum Connection Diagram: 6-position distribution control

LHD shown


Re-circ. flap actuator
Vacuum supply take off
Water valve microswitch
Water valve
Vacuum delay valve
Vacuum reservoir
6
2
8
2
3
4
1
5
FLV 2nd stage
Re-circ flap actuator (a.c. only)
vacuum supply
FLV 1st stage
Footwell/screen actuator
1
5
2
4
3
6
2

## PE.4. - REFRIGERANT HANDLING

The refrigerant used in the air conditioning system is 'Freon 12' and the following precautions MUST ALWAYS BE OBSERVED.

1. Unless absolutely necessary, do NOT discharge refrigerant gas into the atmosphere - use a refrigerant recovery/recycling station in accordance with the manufacturer's instructions.

2. Do NOT discharge refrigerant vapour into an enclosed area where there is a naked flame. Heavy concentrations of refrigerant when exposed to a naked flame produces a toxic gas, which will also attack metal.

3. Do NOT leave refrigerant drums open - always make sure the caps are securely closed.

4. Do NOT transport drums of refrigerant in the passenger compartment of a car.

5. Do NOT expose refrigerant drums to high temperature.

6. Do NOT weld or use a steam cleaner in close proximity to any part of the air conditioning system.

7. Do NOT expose the eyes to vapourised or liquid refrigerant - ALWAYS wear safety goggles when handling refrigerant.

## PE.5. - REFRIGERANT PIPEWORK PRECAUTIONS

The following precautions must be observed when carrying out any work on the refrigerant pipework: Before disconnecting any refrigerant pipework, the system must first be discharged of all pressure. To avoid discharging refrigerant into the atmosphere, a refrigerant recovery/recycling station should be used whenever possible. If no such facility is available, proceed as follows:

1. ALWAYS WEAR SAFETY GOGGLES WHEN OPENING REFRIGERANT CONNECTIONS.
   Cover either connection at the receiver-drier with a cloth to protect from spray, and slacken the connection SLOWLY, allowing any pressure present to bleed off before slackening a further 'flat', and continuing in this manner until all pressure has been expelled (approximately 2 to 3 minutes).

2. Pipes, flexible end connections and components, must be capped immediately they are opened to prevent the ingress of moisture and/or dirt.

3. All replacement components and flexible end connections are sealed when new, and should only be opened IMMEDIATELY PRIOR TO FITTING, AND AT ROOM TEMPERATURE, to prevent condensation of any moisture which may enter when the sealing is removed.

4. The receiver-drier should be the LAST component to be connected, to ensure optimum dehydration and maximum moisture protection of the system.

5. All joints should be coated with refrigeration oil before making any connections, as this will aid seating.

6. Great care must be taken to prevent damage to the pipe fittings and

connections, since due to the high pressures involved, a leak can be caused by the slightest imperfection. Always use two spanners of the correct size when releasing or tightening any pipe joint so that the fixed part of the union may be prevented from twisting and damaging the component. This is especially important with the aluminium condenser.

7. All pipes and hoses must be free from any kinking. The efficiency of the system can be impaired by a single kink, or restriction. Flexible hoses should not be bent to a radius which is less than ten times the diameter of the hose.

## PE.6 - EVACUATION & CHARGING PROCEDURE

**SPECIFIED REFRIGERANT CHARGE = 795 ± 55 GRAMS (28 ± 2 OZ)**

When evacuating or charging the a/c system, the directions of the manufacturer of the charging trolley should be used in conjunction with the following:

1. Check that all manifold hand valves of the gauge set are closed.

2. Connect the charging hoses to the suction (low) and discharge (high) service valves, to be found at the left hand front of the engine bay;
   - the low pressure vapour line valve (7/16" UNF) is fitted in the pipe between evaporator and compressor.
   - the high pressure liquid line valve (3/8" UNF) is fitted in the pipe between condenser and receiver-drier.

   Tighten the hoses by hand only. DO NOT USE PLIERS.

3. Start the vacuum pump, and open the valve to the vacuum pump fully. Slowly open the low side manifold hand valve. The low side gauge should pull into a vacuum (approx. 98 kPa) and the high side gauge should be slightly below the zero index of the gauge. If the high side does not register, check the system, for blockage or leak. Refer to steps 10 and 11.

4. After running the vacuum pump for five minutes, close the valve to the vacuum pump and switch the pump off. If vacuum pressure is stable, proceed to step 5. If however the vacuum reading decreases, a leak is indicated. Refer to step 11 for leak testing procedure.

5. After evacuating the system for 30 minutes, close both the low and high hand valves, close the valve to the vacuum pump, then stop the vacuum pump.

6. WEAR SAFETY GOGGLES

7. Open the centre charging hose to the charging cylinder at the gauges. Open the tap at the bottom of the charging cylinder. Do not open the low and high side hand valves on the manifold gauge at this time.

8. Take note of the level of liquid R12 in the charging cylinder.

9. DO NOT START THE ENGINE

10. Partially charge the system with 200 grams of R12 by slowly opening the high side manifold hand valve. Close the valve when this is completed. Leak test

the system (see next step). If no leak is found, proceed with the charging.

11. **LEAK TEST:** With pressure in the system, check the complete system for leaks using a suitable leak detector.
    Note: When checking joints, or the drain hose, place the leak detector probe below the suspect area as the gas is heavier than air.
    Rectify any leak before proceeding with charging the system.

12. Reopen high side hand valve. Allow as much refigerant to enter the system as possible, but do not exceed the specified charge. When R12 flow stops, close the high side hand valve.

13. Rotate the compressor by hand for 12 revolutions to ensure no liquid refrigerant is trapped in the suction side of the compressor. Failure to perform this check may result in damage to the compressor.

14. Start the engine, select air conditioning, and switch the blower fan to full speed.

15. With the engine idling at 1000 rpm, complete the charging of the system by slowly opening the low side manifold hand valve until the specified amount is in the system.
    CAUTION: Do not allow more than 275 kPa (40 psi) to register on the low pressure gauge.

16. Observe gauge readings, engine system and evaporator outlet temperature for several minutes. If the unit operates satisfactorily, close the stop valve on the compressor end of the high side gauge hose, and open both high and low side manifold hand valves until the pressures equalise. When pressures are equal, close both manifold hand valves and remove the hoses from the service ports on the system.

17. Replace dust caps.

**WARNING: NEVER RUN THE COMPRESSOR WITHOUT REFRIGERANT IN THE SYSTEM, OR THE COMPRESSOR WILL BE DAMAGED.**

## PE.7 - REFRIGERANT OIL

The internal working parts of the compressor are lubricated by refigerant oil. This is a special type of oil which has an affinity with the refrigerant, such that a proportion of the oil circulates, with the refrigerant, around the whole system. Under normal operating conditions, the oil never needs changing or replenishing, and if the correct procedure for system depressurisation and re-charging is followed, no oil will be lost from the system during these operations. If, however, the system suffers a major leak or sudden de-pressurisation, some of the oil held in suspension will be lost as the refrigerant escapes. If a refrigeration component is to be replaced, the removed item will contain a certain amount of oil, and a corresponding amount of new oil must be added to the system on re-assembly (see later).

### Oil Level Check

In order to check the quantity of oil in the system, it is necessary to remove the compressor from the vehicle and drain and measure the oil from within it. Before this is done, it is preferable first to run the system for several minutes to ensure that the oil is distributed around the system in the normal manner.

1. If possible, check that the system is fully charged with refrigerant, and then run the engine at idle speed for 15 minutes with the air conditioning switched on, and the blower fan at full speed.

2. De-pressurise the system, and remove the compressor from the engine (see section PE.8).

3. Remove the oil drain plug from the back of the compressor, and drain the oil into a graduated flask. Refit the drain plug using a new 'O' ring, and tighten to 15 Nm (11 lbf.ft).

4. Remove the oil filler plug from the compressor body, and dependent on whether or not it was possible to run the refrigeration system prior to this check (step 1), add new refrigerant oil as follows:

   If system run prior to check

   | Collected Amount | Refill Amount |
   |---|---|
   | More than 60 cc (2.0 fl.oz) | Same as collected amount |
   | Less than 60 cc (2.0 fl.oz) | 60 cc (2.0 fl.oz) |

   **TABLE 1**

   Refit the oil filler plug using a new 'O' ring and tighten to 15 Nm (11 lbf.ft). Refit the compressor (see section PE.8).

   If system was not run prior to check

   | Collected Amount | Refill Amount |
   |---|---|
   | More than 50 cc (1.7 fl.oz) | Same as collected amount |
   | Less than 50 cc (1.7 fl.oz) | 50 cc (1.7 fl.oz) + see below |

   **TABLE 2**

   Refit the oil filler plug using a new 'O' ring and tighten to 15 Nm (11 lbf.ft). Refit the compressor (see section PE.8).
   Carry out this complete procedure again, starting by running the system as in step 1, and using table 1 to check the oil quantity.

Refrigerant Oil Specification

Use only a high quality refrigerant oil of viscosity SUS 500/100°F.

Component Replacement

If a system component is to be replaced, refrigerant oil in the following quantities must be added to the components before fitting:

| | |
|---|---|
| Evaporator | 30 - 40 cc (1.0 - 1.4 fl.oz) |
| Condenser | 30 - 40 cc (1.0 - 1.4 fl.oz) |
| Receiver-drier | 10 - 15 cc (0.3 - 0.5 fl.oz) |

Compressor New compressors are supplied with 100 cc (3.4 fl.oz) of oil already included. Drain this oil out, and refill with oil in accordance with the quantity drained from the old compressor, as specified in 'Table 1' above.

In all cases, if a system failure resulted in a sudden pressure loss, resulting in the refrigerant suspended oil being lost, the system should be entirely flushed and the compressor drained and refilled with 100 cc (3.4 fl.oz).

## PE.8 - COMPRESSOR

The compressor is mounted on the left hand front of the cylinder block, and is driven by a multi-vee belt, shared with the PAS pump, from the crankshaft. The belt tension is adjusted by moving the PAS pump as follows:

- Slacken the pivot bolt at the top of the PAS mounting bracket, and the two bolts securing the adjuster strap.
- Move the pump bracket to achieve the correct belt tension of 145 ± 15 kg using a Burroughs gauge.
- Tighten the three fixing bolts to 18 Nm (13 lbf.ft).

The compressor and clutch assembly comprises a non-serviceable assembly, which must be replaced as a complete unit if found to be faulty.

### Compressor Removal

1. If the compressor is operational, first run the system as detailed in 'Refrigerant oil level check'.

2. De-pressurise the a/c system (see section PE.5) and disconnect both hoses from the compressor. Immediately cap the hoses and compressor ports.

3. Disconnect the lead to the compressor clutch.

4. Remove the two bolts securing the steady strap at the top of the compressor, and the single bolt from beneath the compressor, and remove the unit, unhooking the drive belt.

5. Remove the oil drain plug, and drain and measure the oil quantity.

### Compressor Re-fitment

New compressors are filled with 100 cc (3.4 fl.oz) of refrigerant oil, and nitrogen gas. Before fitting, slowly release the nitrogen gas from both the suction and discharge ports. Drain the oil and refill as detailed in section PE.7.

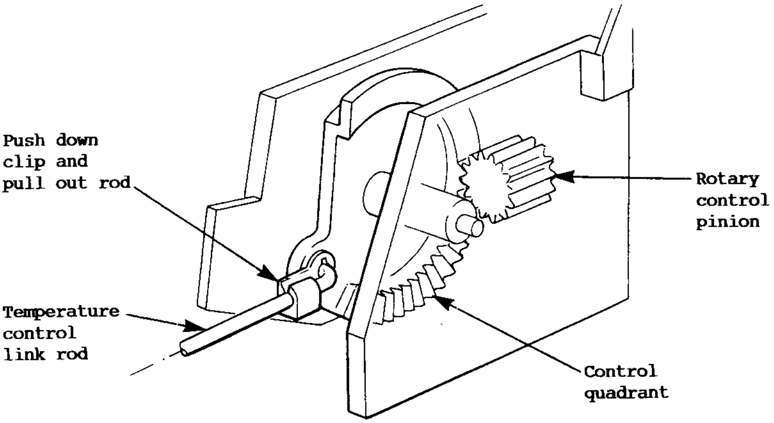
Re-fit the compressor in reverse order to removal, torque tightening the three bolts to 40 Nm (30 lbf.ft). Check the drive belt tension as above.

## PE.9 - CLIMATE CONTROL PANEL

To remove the climate control panel, consisting of the distribution control, fanspeed switch and temperature control, the fascia mask must be removed:

1. Use the release forks to withdraw the radio unit, and disconnect the aerial lead, speaker harnesses, and power and earth leads.

2. Loosen the glovebox stop bracket, and allow the glovebox to swing down fully. From the glovebox aperture, reach behind the climate control panel, and unclip the temperature control link rod from the control quadrant. Also pull off the vacuum pipes connector plug from the rotary control.


**Push down clip and pull out rod**
**Rotary control pinion**
**Temperature control link rod**
**Control quadrant**

3. Remove the steering wheel: **For USA vehicles fitted with a Supplementary Inflatable Restraint (S.I.R.), see Service Notes Manual WB for precautions and procedure for removing the steering wheel.** On all other vehicles:
   - press the centre horn pad and turn counterclockwise to release from the bayonet type fixing;
   - remove the nut and washer retaining the steering wheel;
   - mark the reletive positions of the wheel and inner column to aid refitting;
   - pull the wheel off the column using minimum force. If necessary, use a suitable puller.

     **DO NOT** apply excessive axial force to either the inner or outer column without the use of a steering wheel puller, or the mechanism retaining the telescopic length of the collapsible column may be overridden, necessitating column replacement.

4. Remove the column shrouds. Press down the plastic tabs retaining the column switches, and slide the switches from their carrier bracket.

5. Release the two screws, and remove the instrument access panel from the top of the binnacle. Disconnect the speedo cable, and the three instrument/ switch harness connector blocks. Release the three fixings securing the fascia mask to the main fascia.

6. Remove the two blanking plugs in the bottom edge of the driver's side fascia, and release the two fixing screws.

7. Remove the blanking plug at the bottom of the fascia mask, adjacent to the cigar lighter, release the lower fixing, and withdraw the fascia mask.

8. Release the two screws securing the climate control panel into the fascia mask, and withdraw.

To refit the climate control panel, reverse the removal procedure, noting the following points:

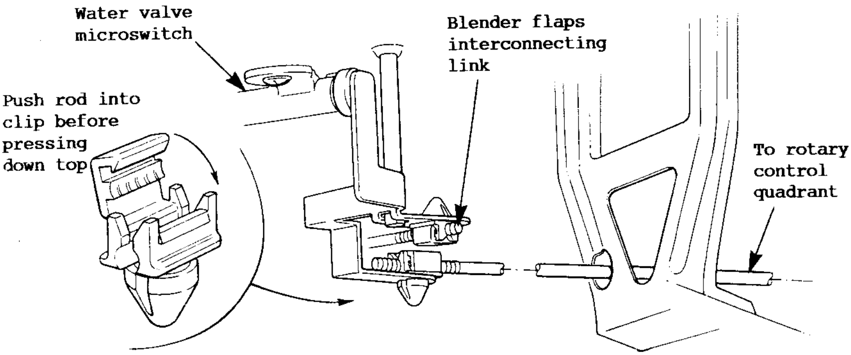
- when refitting the radio, use the access provided by the glovebox aperture to ensure that the spigot on the back of the radio engages with the support bracket fixed to the scuttle brace.
- torque tighten the steering wheel nut to 40 Nm (30 lbf.ft).

If the temperature control link rod has been replaced or disconnected from the heater flaps lever, proceed as follows:

i) Feed the rod through the hole in the scuttle brace, and fit to the temperature control quadrant.

ii) Turn the control to fully cold.

iii) Move the flap lever fully forward (micro-switch operated), and press the forward end of the link rod into the plastic clip. Secure by pressing the hinged top part of the clip into position.


Water valve microswitch
Push rod into clip before pressing down top
Blender flaps interconnecting link
To rotary control quadrant

PE.10 - AIR INTAKE/BLOWER ASSEMBLY

The air intake/blower assembly connects with the air intake duct at the front bulkhead and houses the four speed blower fan. The unit is not 'handed' and so fits in a different orientation on right and left hand drive cars. On heater only cars, the flap valve is fixed so as to admit fresh air from the intake duct at all times, whereas cars equipped with air conditioning utilise the flap to provide either a fresh air intake, or close off the fresh air and open a re-circulation vent. The re-circ. position is used mainly with air conditioning for maximum refrigeration, but may also be used to close off the air intake in heavy traffic to avoid drawing fumes into the car. The flap is operated by a vacuum actuator mounted on its inboard side (see section PE.2 & 3).

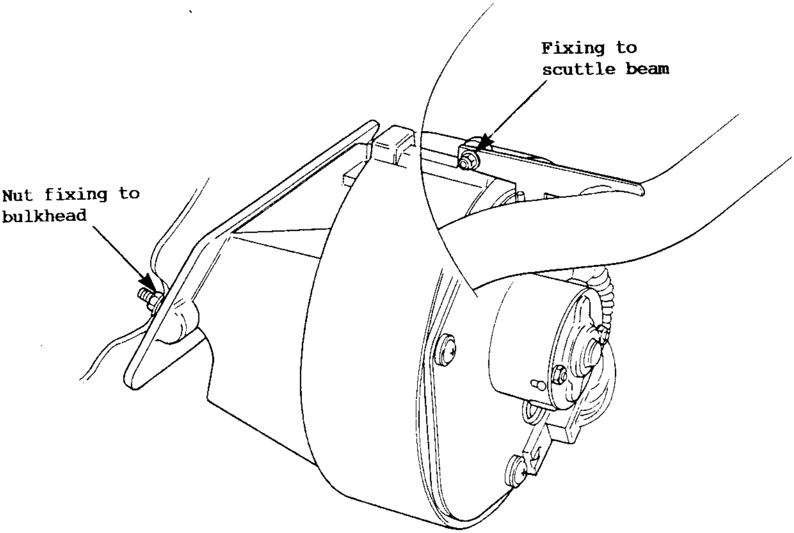
To remove the air intake/blower assembly:

1. Remove the main fascia (see section VD).

2. On a/c cars, remove the engine management ECM and mounting bracket from the underside of the blower and evaporator casings.

3. Disconnect the blower motor and resistor block. On a/c cars, pull off the re-circ. actuator vacuum hose.

4. Release the two nuts securing the unit to the bulkhead at each side of the air intake adaptor.



4. Release the single fixing securing the top of the unit to the scuttle beam, and release the fascia harness from the scuttle bracket. Withdraw the assembly from the evaporator casing (a/c cars) or air ducting (heater cars).

   Refit the unit in the reverse order to removal.

PE.11 - EVAPORATOR ASSEMBLY

The evaporator assembly comprises the evaporator with expansion valve, fitted in a casing interposed between the blower unit and heater/distribution housing. For access the the evaporator or expansion valve, the unit must be removed from the car.

To remove the evaporator assembly:

1. Remove the main fascia (see section VD).

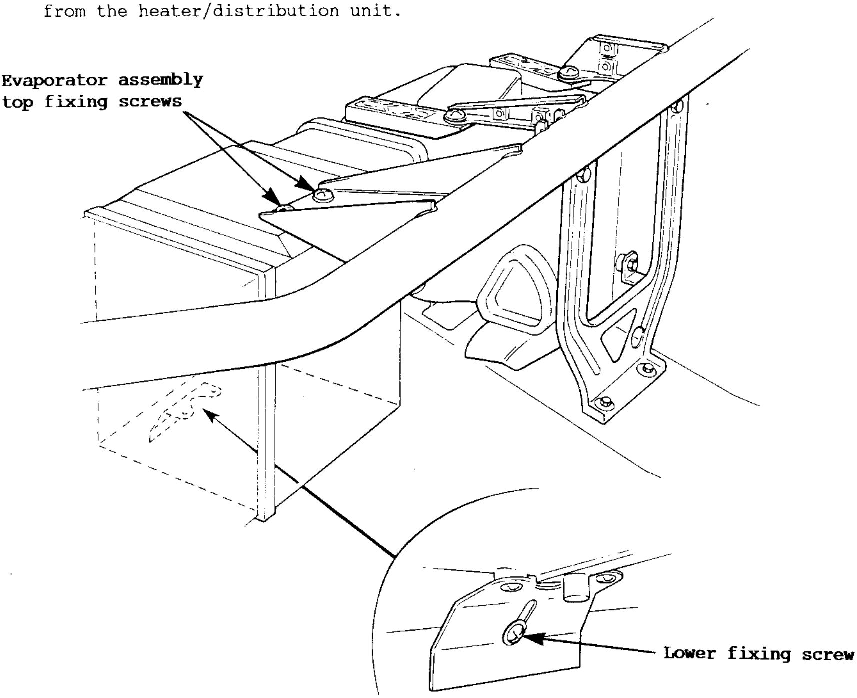
2. Remove the air intake/blower assembly (see above).

3. De-pressurise the refrigerant system (see section PE.5).

4. Using two spanners on each connection, disconnect the two a/c pipes from the evaporator at the back of the engine bay.

5. Disconnect the thermostat, and the evaporator drain tube.

6. Release the lower fixing bracket from the bulkhead, and the two fixings securing the top of the unit to the scuttle beam, and withdraw the assembly from the heater/distribution unit.



7. If necessary, separate the two halves of the casing for access to the evaporator or expansion valve. Take care not to damage the capillary lines from the thermostat or expansion valve.

To re-assemble and refit the unit, reverse the removal procedure, noting the following points:

- When re-fitting the expansion valve, use a new 'O' ring coated with refrigerant oil, at each connection, and torque tighten to:
  inlet; 11 - 16 Nm (8 - 12 lbf.ft).
  outlet; 18 - 23 Nm (13 - 17 lbf.ft).
- Clip the expansion valve capillary line coil to the evaporator outlet pipe, and wrap with anti-drip tape.
- Ensure that the evaporator is sealed in the housing by the foam strips.
- Fit the thermostat to the casing, and ensure that the capillary line is correctly positioned.
- Torque tighten the unit inlet connection to 11 - 16 Nm (8 - 12 lbf.ft).
- Torque tighten the unit outlet connection to 24 - 30 Nm (18 - 22 lbf.ft).

## PE.12 - HEATER/DISTRIBUTION UNIT

The heater/distribution unit consists of a two piece casing containing the heater matrix with its two air mixer flaps, and a distribution chamber with two flaps. The vacuum actuators for the two distribution flaps are mounted on the side of the unit. For access to the heater matrix, the unit must be removed from the car.

To remove the heater/distribution unit:

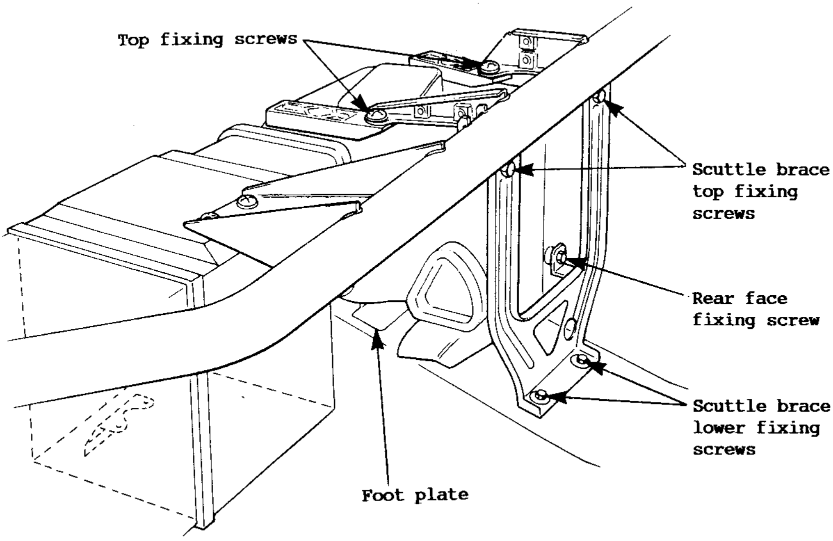
1. Drain sufficient coolant, and disconnect the two heater hoses from the rear of the engine bay.

2. Remove the main fascia (see section VD).

3. Remove the ducting between screen vent outlets on the distribution housing, and the demist ducts in the scuttle. Remove the face level vent ducting.

4. Disconnect the vacuum pipes between the top micro-switch and the re-circ. actuator, the vacuum supply pipe from the 'T' piece, and the pipe between lower micro-switch and the water valve.

5. Release the single screw securing the rear face of the unit to the scuttle brace. Release the 'Maxi' fuse box from the scuttle brace. Release the two fixings securing the brace to the scuttle beam, and the two fixings securing the brace to the chassis tunnel, and withdraw the brace.


Top fixing screws
Scuttle brace top fixing screws
Rear face fixing screw
Scuttle brace lower fixing screws
Foot plate

6. Release the two fixings securing the top of the casing to the scuttle beam, and withdraw the unit from the bulkhead and evaporator housing.

7. To remove the heater matrix from the housing, release the foot plate and clamp bracket from the underside of the unit, and release the operating arm

from the blender flap shaft. Release the screw securing the matrix pipe steady bracket, and withdraw the matrix from the case.

When refitting the heater matrix, ensure that the matrix is fully sealed to the casing with foam.

The interlinking of the two air blender flaps is set at the factory, and should require no subsequent adjustment. However, if the heater/distribution unit is removed from the car, the setting may be checked or adjusted as follows:

- Unclip the fastener from the adjustable end of the link rod, move both flaps to the 'hot' position, and refit the rod into the fastener.
- Check that the flaps move freely between the hot and cold positions.

Refit the heater/distribution housing in the reverse order to removal. After refitting the fascia mask and climate control panel, it will be necessary to re-adjust the temperature control link rod as detailed in section PE.9.

# CLUTCH

## SECTION QD - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | QD.1 | 2 |
| Clutch Cable | QD.2 | 2 |
| Release Bearing & Fork | QD.3 | 4 |
| Clutch Assembly | QD.4 | 5 |

## QD.1 - GENERAL DESCRIPTION

The driving element of the clutch assembly consists of the rear face of the engine flywheel, and a pressure plate fixed to the flywheel via the spring diaphragm clutch cover assembly. The driven element, is a single, dry, double sided friction plate, splined to the gearbox input shaft, and interposed between the flywheel and pressure plate. The diaphragm spring in the clutch cover clamps the friction plate between the pressure plate and flywheel to provide the drive connection between engine and gearbox. The gearbox input shaft, on which the friction plate is free to slide axially, is 'overhung' from the gearbox, with no spigot bearing in the rear end of the crankshaft.

The clutch release mechanism uses a control cable to connect the clutch pedal to a lever arm on the transmission. The lever arm turns a shaft onto which is fixed, inside the clutch housing, a release fork which in turn, presses a ball bearing race against the inner ends of the fingers of the diaphragm spring. This action causes the diaphragm fingers to pivot about their fulcrum, and relieve the clamping force applied to the pressure plate via the diaphragm outer edge. The release bearing slides on a guide sleeve which surrounds the gearbox input shaft.

## QD.2 - CLUTCH CABLE

The clutch cable connects the pedal with a lever arm on the clutch housing, with rubber isolators used at each end at the outer cable abutments to reduce the transmission of powertrain noise into to the cabin via the cable. On later cars, a further reduction in transmitted noise is acheived by the inclusion of a mass damper - a steel block - at the transmission end of the cable. The cable is nylon lined and requires no lubrication. At service intervals, the clutch cable should be adjusted to provide the specified amount of free play at the lever arm. As the friction plate wears, the free play will be reduced, and if insufficient allowance is made, clutch slip will eventually result as a consequence of a preload being applied to the release mechanism.

### Introduction of Clutch Cable Mass Damper

All cars built from approximately December 1990 onwards, are fitted with a lengthened clutch cable to accomodate a mass damper at the transmission end. The damper is a mild steel block which grips the clutch cable outer via a rubber sleeve. The inertia of the block is used to damp down the high frequency vibrations transmitted from the power unit to the cabin via the clutch cable.

If replacing the clutch cable, first determine whether a mass damper is fitted (see illustration). If no damper is fitted, use the 'B' level cable:

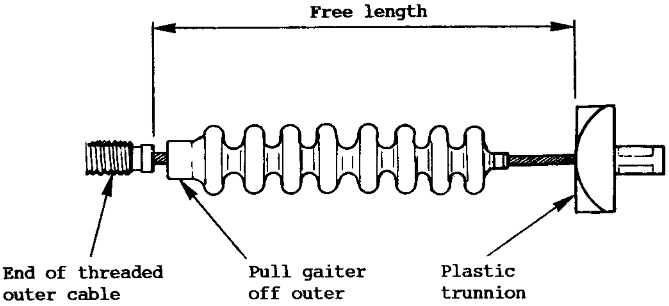
| | |
|---|---|
| Clutch Cable, RHD | B100Q6008F |
| Clutch Cable, LHD | B100Q6007F |

When stocks of these cables are exhausted, it will be necessary to fit the longer 'C' level cable together with the damper and sleeve:

| | |
|---|---|
| Clutch Cable, RHD | C100Q6008F |
| Clutch Cable, LHD | C100Q6007F |
| Mass Damper, clutch cable | A100Q0007F |
| Rubber Sleeve, damper to cable | A100Q0008F |

To identify a clutch cable, measure the inner cable free length at the transmission end (pedal end disconnected).

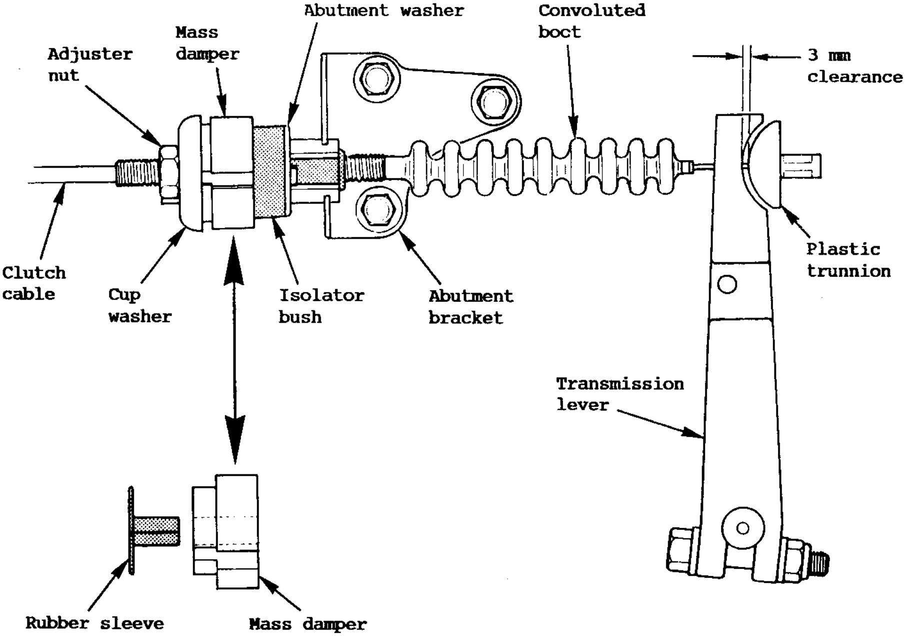
| | | |
|---|---|---|
| 'B' cable free length | - RHD: | 115 mm approx. |
| | - LHD: | 129 mm approx. |
| 'C' cable free length | - RHD: | 143 mm approx. |
| | - LHD: | 157 mm approx. |


Free length
End of threaded outer cable
Pull gaiter off outer
Plastic trunnion

To fit the mass damper:

1. Pull the convoluted boot from the end of the outer cable threaded portion, and slide the isolator bush off the thread.

2. Fit the mass damper and rubber sleeve over the inner cable. Push the sleeve into the damper before sliding the damper onto the threaded outer cable up to the cup washer. Push the isolator bush and abutment washer back onto the thread, and fit the cable into the transmission abutment bracket. Check that the tag on the isolator abutment washer fits into the slot in the bracket, and that the cup washer tag fits against a flat on the adjuster nut. Refit the rubber boot.


Abutment washer
Convoluted boot
Mass damper
Adjuster nut
3 mm clearance
Clutch cable
Cup washer
Isolator bush
Abutment bracket
Plastic trunnion
Transmission lever
Rubber sleeve
Mass damper

To Adjust

Before adjusting the cable, first check that the clutch pedal upstop is adjusted so as to allow similar pedal heights of clutch and brake pedals.

Pull apart by hand, the plastic trunnion and the transmission lever, and measure the clearance which should be 3 mm. If necessary, adjust the clearance by pulling the outer cable and adjuster nut clear of the cup washer tag, and turn the nut as required. After adjustment, ensure that the nut sits flush against the cup washer with the tag against a flat, and that the tag on the isolator bush abutment washer is engaged in the abutment bracket slot.

Cable Replacement

- Slacken the adjustment at the clutch housing abutment bracket to enable the inner cable to be unhooked from the clutch housing lever arm.
- Pull the isolator bush and cable out of the abutment bracket.
- Unhook the cable from the clutch pedal, and withdraw the cable through the bulkhead.

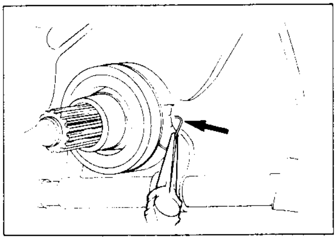
To refit a cable, reverse the removal procedure, and apply a small amount of general purpose grease to the eye at the pedal end of the cable. Adjust as above.

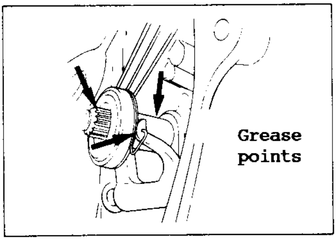
## QD.3 - RELEASE BEARING & FORK

For access to the release bearing and fork, the transmission must be removed from the vehicle: see section FF.

Release Bearing

Unhook each end of the spring clip from the release fork, and slide the release bearing off its guide tube. Check the bearing for excessive play, roughness, noise or any other signs of undue wear, and replace if in any doubt.



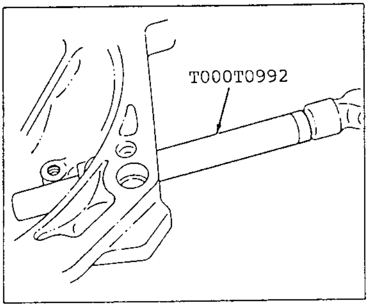


On re-assembly, apply a light coating of high temperature grease, Esso Unirex N3 (A912E6891F), to the input shaft splines, release bearing sliding surface and the contact faces at the ends of the fork. Fit the retainer spring around the release bearing groove, with the ends of the spring angled towards the gearbox casing. Fit the release bearing over the guide tube with the spring 'wrap' away from the fork shaft, and the flats of the bearing against each fork leg. Hook the ends of the spring into the fork leg holes.

Release Fork

The release fork is integral with its shaft, and is removed as follows: Remove the release bearing (see above).

Remove the operating arm from the splined end of the release fork shaft, pull off the dust cap, and prise out the clutch shaft seal. Use the special tool or a suitable tube to knock the shaft bush along the shaft and into the housing. Unhook the shaft spring and withdraw the shaft from within the housing.



Clutch Shaft Bush Inserter/Replacer
T000T0992

To replace: Apply high temperature grease to the bearing surfaces of the shaft and fork. Insert the shaft into the housing from the inside, locate the spring over the shaft end, and fit the shaft into the end bush. Use tool T000T0992 to fit the outer bush into position, followed by the seal. Fit the dust cap and operating arm, noting that the arm may be fitted in one position only. Torque tighten the arm pinch bolt to 38 Nm (28 lbf.ft).

## QD.4 - CLUTCH ASSEMBLY

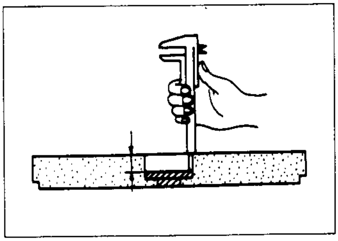
For access to the clutch assembly, the transmission must be removed from the vehicle: see transmission section FF.

The diaphragm pressure plate assembly is secured to the flywheel by six bolts, and located by three dowels. Release the fixing bolts evenly and progressively to prevent distortion of the clutch cover. Remove the cover assembly and centre (friction) plate.

### Inspection

Inspect the condition of the clutch friction plate linings for wear, oil contamination or any other damage. Check for signs of excessive wear on the splines, and check that none of the cush drive springs in the drive plate hub are broken. If in doubt, replace the component.

Lining rivet depth
- new; 1.3 - 1.9 mm
- service limit; 0.2 mm



Inspect the condition of the wearing surfaces on the flywheel and pressure plate, and renew the component if there is evidence of excessive wear, scoring, or other damage. If there are any signs of overheating through excessive clutch slip, characterised by a 'blueing' of the friction surfaces, distortion is likely to have occurred, and weakening of the diaphragm spring. Replace the clutch cover assembly, and check the runout of the flywheel face.

To Replace Flywheel

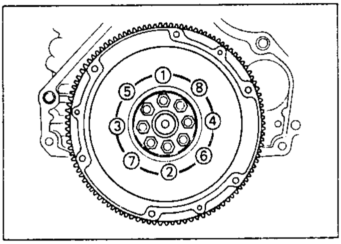
i) Release the six bolts, and remove the flywheel from the crankshaft.

ii) Thoroughly degrease the threads in the crankshaft, and the crankshaft and flywheel mating faces. Apply Loctite 262 or similar thread locking compound to the threads of NEW flywheel fixing bolts, insert through the flywheel washer, and secure the flywheel to the crankshaft.
**Note:** Do not apply an excessive amount of sealer to the bolt threads, or the resultant overflow may contaminate the bolt seating face and cause the bolt to work loose.

iii) Hold the flywheel from turning, and tighten the fixing bolts in a diagonal sequence to the specified torque in 2 steps using the angular tightening method as shown in the table.

Flywheel bolt tightening:

| 1st step | 2nd step |
|---|---|
| 30 Nm (22 lbf.ft) | 45° - 60° |



To Refit Clutch Assembly

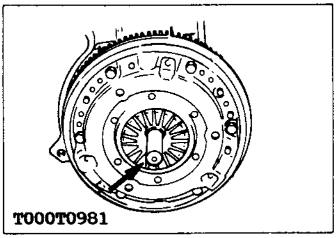
- Check that the plastic plug used for locating the clutch alignment mandrel is fitted into the rear end of the crankshaft.
- Fit the friction plate, the correct way round, to the flywheel, and retain with the clutch cover assembly.

**NOTE:** Both the friction plate and cover assembly differ for N/A and Turbo models. Check that the correct parts are fitted:

| | | | |
|---|---|---|---|
| Identification - friction plate | - N/A | 215 mm o/d | |
| | - Turbo | 225 mm o/d | |
| - cover assembly | - N/A | 8944818580 | (440 kgf) |
| | - Turbo | 8944671122 | (500 kgf) |

- Fit the clutch alignment mandrel through the friction plate and into the crankshaft plug, and tighten the six clutch cover fixing screws evenly and progressively to 19 Nm (14 lbf.ft). Remove the mandrel and leave the crankshaft plug in place.

Clutch alignment mandrel T000T0981



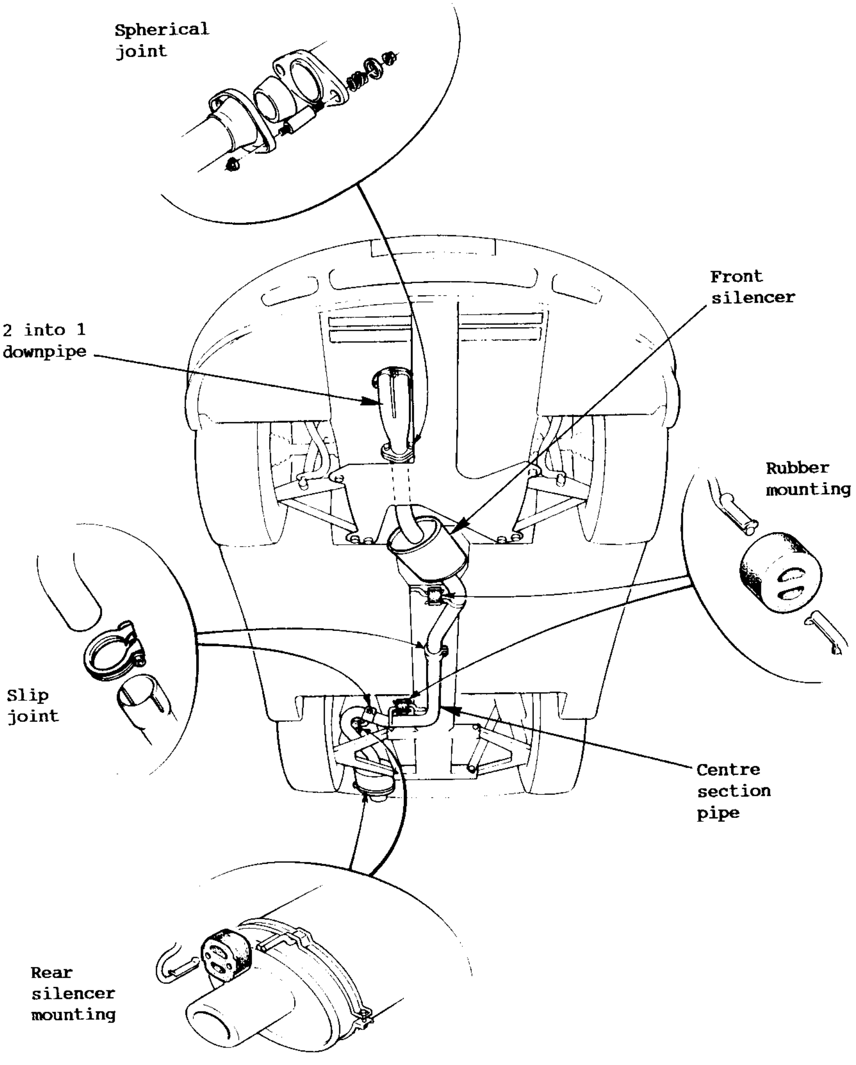
- Refit the transmission assembly: see section FF.

# SECTION SD

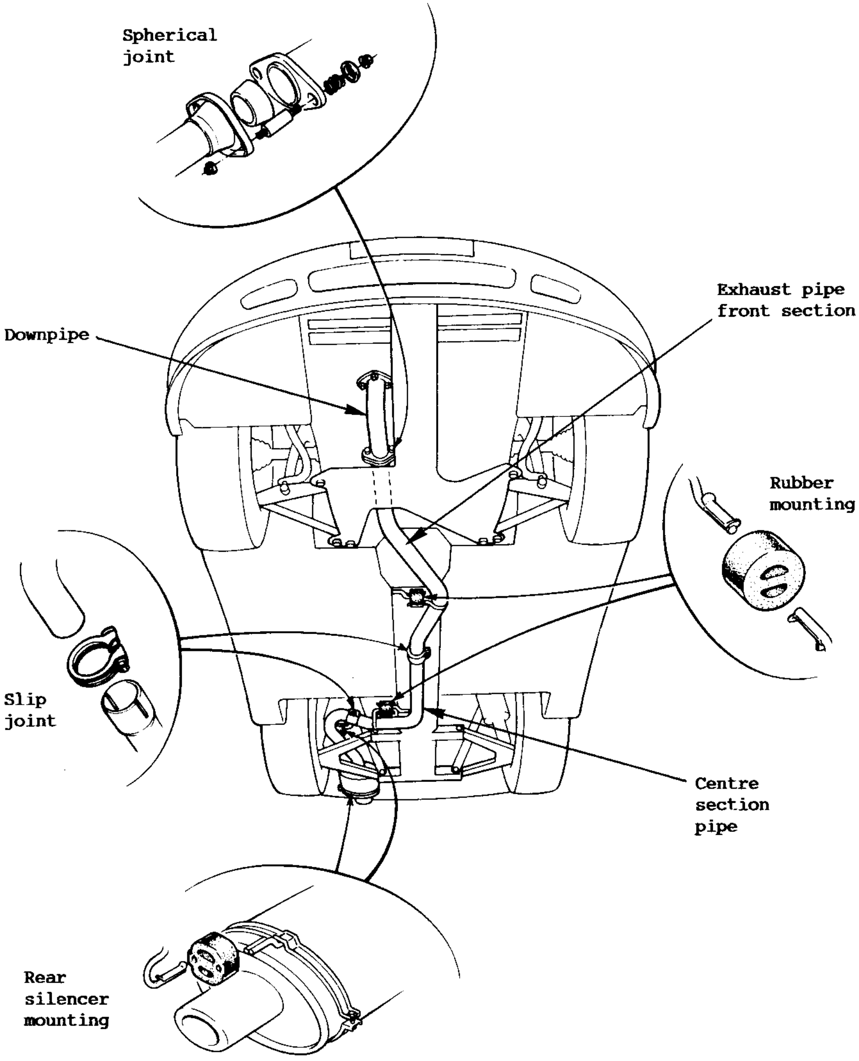
## EXHAUST SYSTEM - ELAN

| | Sub-Section | Page |
|---|---|---|
| General Description | SD.1 | 5 |
| Exhaust System Mountings | SD.2 | 7 |
| Clamps and Joints | SD.3 | 8 |
| Heat Shields | SD.4 | 9 |

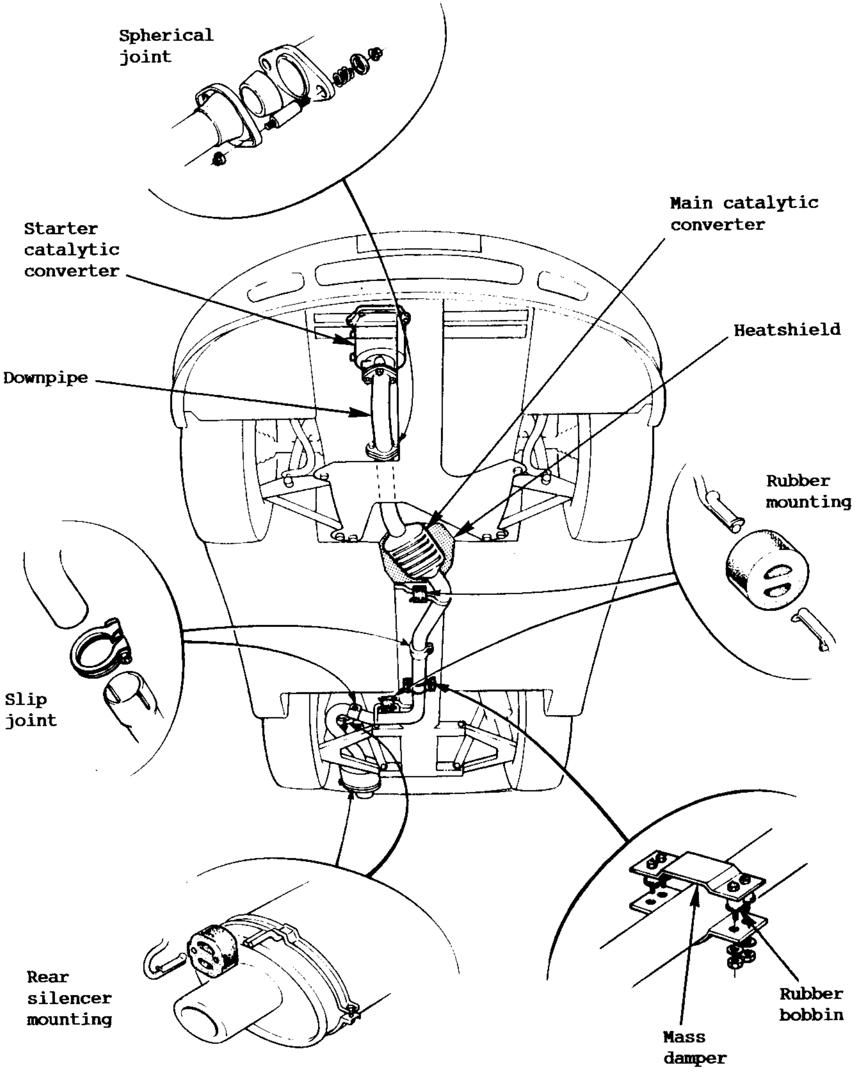
## Naturally Aspirated Exhaust System


Spherical joint
2 into 1 downpipe
Front silencer
Rubber mounting
Slip joint
Centre section pipe
Rear silencer mounting

## Non-Catalyst Turbo Exhaust System


Spherical joint
Exhaust pipe front section
Downpipe
Rubber mounting
Slip joint
Centre section pipe
Rear silencer mounting

## Catalyst Turbo Exhaust System


Spherical joint
Starter catalytic converter
Downpipe
Main catalytic converter
Heatshield
Rubber mounting
Slip joint
Rear silencer mounting
Mass damper
Rubber bobbin

## SD.1 - GENERAL DESCRIPTION

There are three variations of exhaust system dependent on model:

i) Naturally Aspirated;
ii) Non-Catalyst Turbo;
iii) Catalyst Turbo.

### Naturally Aspirated

- The cast iron exhaust manifold bolted to the front of the engine, collects exhaust gas from cylinder head ports 1 & 4, and 2 & 3, and maintains this stream separation to the downpipe flange.
- A two-into-one downpipe bolts to the manifold flange, loops under the engine sump, and terminates at the back of the engine in a two bolt flange.
- A front silencer section bolts to the front pipe via a spherical joint which uses a fibre and steel wool moulded sealing ring between the spigot on the downpipe, and the shaped end of the front silencer pipe. The joint is sealed by the pressure exerted by a coil spring fitted over each of the two shouldered studs fitted to the silencer pipe flange. The front part of the silencer pipe runs above the engine bay underframe, and is formed into a 'D' section at this point to provide sufficient clearance. The front silencer is a straight through absorption type.
- A centre section pipe uses a slip joint at each end to connect with the front silencer section and the rear silencer inlet pipe.
- The rear silencer inlet pipe runs over the right hand rear lower wishbone before joining the oval section silencer, whose oval tailpipe exits through a slot in the rear valance. The baffle and absorption type rear silencer is similar to that used on Turbo models, but differs internally to provide the necessary higher degree of muffling.

For identification of the rear silencer, refer to the homologation number stamped on the underside of the casing: HOMGN L0890076

Aluminised mild steel is used for the manufacture of the entire system with the exception of some stainless steel internal parts of the rear silencer.

### Non-Catalyst Turbo

- A cast iron manifold collects exhaust gas from the four cylinder head ports, and feeds into the turbine housing of the turbocharger. The outlets of the turbine housing, both main and wastegate, feed into a cast iron outlet elbow which connects with a starter catalyst housing at the front of the engine. On non-catalyst versions, this housing is an empty chamber supported by a bracket to the front of the cylinder block, and which terminates in a three stud flange.
- A downpipe bolts to the flange of the starter catalyst housing, and leads beneath the engine sump to a two bolt flange at the back of the engine. On cars built from January 1991 onwards, a steel support stap is bolted between a tab on the downpipe rear flange, and the driveshaft fixing bracket on the rear of the engine.
- An exhaust pipe front section bolts to the front pipe via a spherical joint which uses a fibre and steel wool moulded sealing ring between the spigot on the downpipe, and the shaped end of the front silencer pipe. The joint is sealed by the pressure exerted by a coil spring fitted over each of the two shouldered studs fitted to the front section pipe flange. The front part of the pipe runs above the engine bay underframe, and is formed into a 'D' section at this point to provide sufficient clearance.
- A centre section pipe uses a slip joint at each end to connect with the front section and the rear silencer inlet pipe.
- The rear silencer inlet pipe runs over the right hand rear lower wishbone

before joining the oval section silencer, whose oval tailpipe exits through a slot in the rear valance. The baffle and absorption type rear silencer is similar to that used on the N.A. model, but differs internally to produce less back pressure.

For identification of the rear silencer, refer to the homologation number stamped on the underside of the casing: HOMGN L0880069

Stainless steel is used for the downpipe, with the remainder of the system manufactured from aluminised mild steel.

Catalyst Turbo

- A cast iron manifold collects exhaust gas from the four cylinder head ports, and feeds into the turbine housing of the turbocharger. The outlets of the turbine housing, both main and wastegate, feed into a cast iron outlet elbow (into which is fitted the engine management oxygen sensor) which connects with a starter catalyst housing at the front of the engine. This cast iron cylindrical housing contains the starter catalyst which being close to the engine, heats up to operating temperature quickly, and in so doing helps the main catalytic converter to reach operating temperature sooner. On Japanese market cars, the bottom of the housing is fitted with a temperature sensor to warn against catalyst overheating. The housing is supported by a bracket to the front of the cylinder block, and terminates in a three stud flange.
- A downpipe bolts to the flange of the starter catalyst housing, and leads beneath the engine sump to a two bolt flange at the back of the engine.
- The main catalytic converter bolts to the front pipe via a spherical joint which uses a fibre and steel wool moulded sealing ring between the spigot on the downpipe, and the shaped end of the converter inlet pipe. The joint is sealed by the pressure exerted by a coil spring fitted over each of the two shouldered studs fitted to the converter pipe flange. The front part of the pipe runs above the engine bay underframe, and is formed into a 'D' section at this point to provide sufficient clearance.

The 'three way' catalytic converter contains an oxidising catalyst, platinum, which uses the presence of oxygen in the exhaust gas to convert HC (hydrocarbons) and CO (carbon monoxide) to water vapour and carbon dioxide. A reducing catalyst, rhodium, helps to remove oxygen from NOx (nitrogen oxide) to leave nitrogen. The converter reaches very high temperatures during operation, and is fitted with a heat shield on its underside to reduce the danger of grass fires. A heat shield is also fitted to the chassis above the converter in order to protect the chassis and rear engine mounting from the effects of excessive heat.

- A centre section pipe uses a slip joint at each end to connect with the converter outlet pipe and the rear silencer inlet pipe. A vibration damper fitted to the middle of this pipe, takes the form of a steel plate mass damper mounted over the pipe via four rubber bobbins. The bobbins straddle the exhaust pipe and bolt to a bracket welded to the pipe underside.
- The rear silencer inlet pipe runs over the right hand rear lower wishbone before joining the oval section silencer, whose oval tailpipe exits through a slot in the rear valance. The baffle and absorption type rear silencer is similar to that used on the N.A. model, but differs internally to produce less back pressure.

For identification of the rear silencer, refer to the homologation number stamped on the underside of the casing: HOMGN L0880069

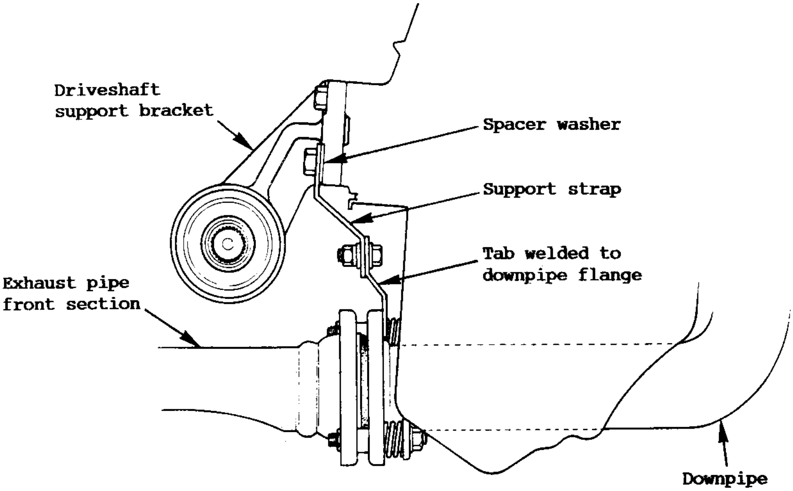
Stainless steel is used for the downpipe and catalytic converter, with the remainder of the system manufactured from aluminised mild steel.

## SD.2 - EXHAUST SYSTEM MOUNTINGS

The exhaust system is flexibly suspended from the chassis/body unit by a total of four rubber mountings. These are located:

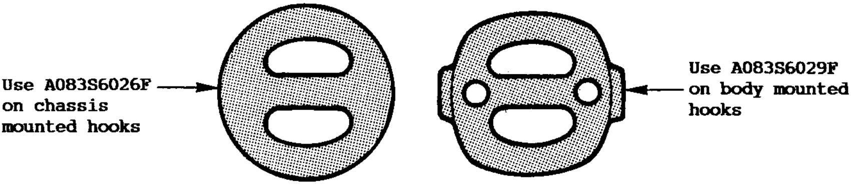
i) Towards the front of the chassis main backbone;
ii) Just ahead of the rear wishbone front pivot point;
iii) Beneath the battery compartment;
iv) At the rear of the boot floor.

In addition, on non-catalyst Turbo models built from approx. January 1991 onwards, a support strap is fitted between a tab on the downpipe rear flange, and the drive shaft mounting bracket on the back of the cylinder block.


Driveshaft support bracket
Spacer washer
Support strap
Tab welded to downpipe flange
Exhaust pipe front section
Downpipe

The rubber mountings use wire rod hooks with load spreading saddles, welded to the exhaust pipe and chassis at the mounting points. At the rear, one hook is bolted beneath the battery compartment, using a pair of M6 studs welded to the battery retaining channel. The rearmost hook is bolted to a bobbin in the boot floor (hook points forward), and picks up on a hook secured to the rear silencer body by a clamp bracket.

Note that two different types of rubber mounting are used, with A083S6026F used for the two chassis mounted hooks, and A083S6029F used for the two rearmost, body mounted hooks.

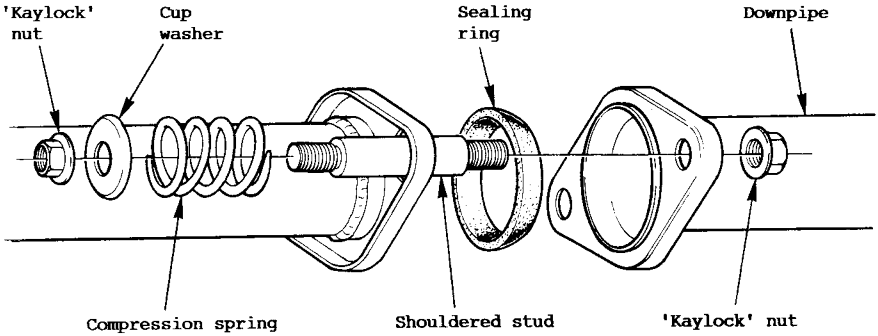

Use A083S6026F on chassis mounted hooks
Use A083S6029F on body mounted hooks

## SD.3 - CLAMPS & JOINTS

### Spherical Joint

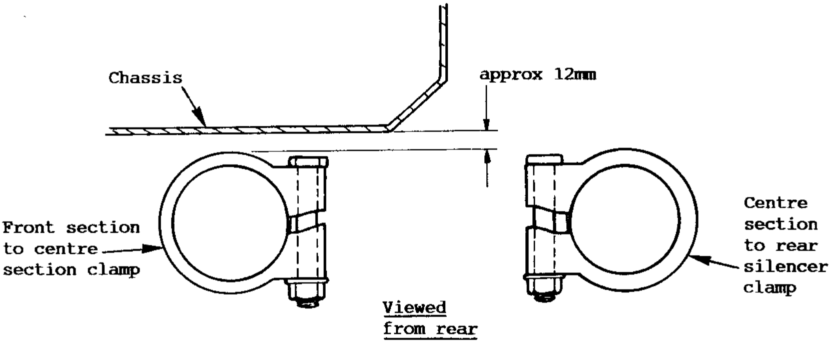
A spherical joint is fitted at the rear end of the downpipe both to ensure alignment of the exhaust system without strain, and to reduce vibration transmitted along the pipe. The joint is assembled dry:

- Fit the sealing ring over the spigot on the downpipe;
- Position the front silencer/front section/catalytic converter, and support on its mounting rubber;
- Fit the two studs through the holes in the downpipe flange and secure to the opposite flange with 'Kaylock' M10 nuts;
- Fit a spring and cup washer over each of the studs, and secure with another 'Kaylock' M10 nut. Tighten the nuts fully to clamp the cup washers against the shoulder on the studs.


'Kaylock' nut
Cup washer
Sealing ring
Downpipe
Compression spring
Shouldered stud
'Kaylock' nut

### Slip Joints

All slip joints should be assembled using a proprietary exhaust paste. The AWAB clamps should be positioned with the bolts vertical, and the bolt thread lubricated with oil before tightening to 15 Nm (11 lbf.ft). Do not tighten the clamps until the exhaust system is fully assembled and positioned for optimum clearance to chassis/body and suspension components.


Chassis
approx 12mm
Front section to centre section clamp
Centre section to rear silencer clamp
Viewed from rear

## SD.4 - HEAT SHIELDS

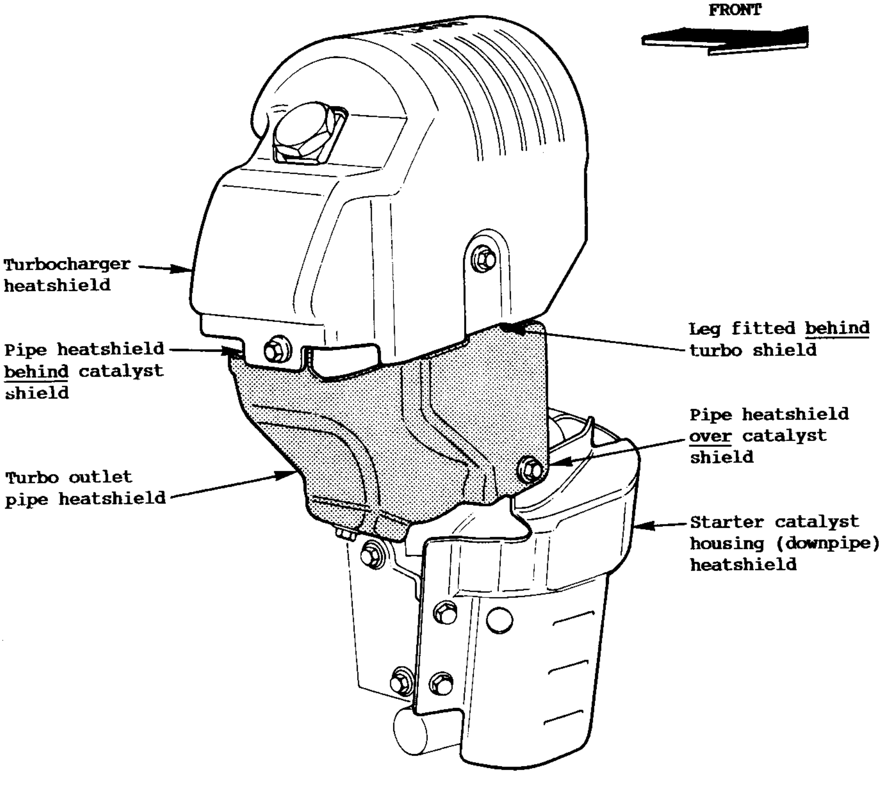
### Engine Mounted Shields

On N.A. vehicles, the only exhaust system heat shields fitted are those behind and in front of the exhaust manifold, both parts being secured to the manifold itself.

Turbocharged models use a three piece heat shield over the top, right hand and left hand ends of the exhaust manifold. A further three shields are used at the front of the engine:

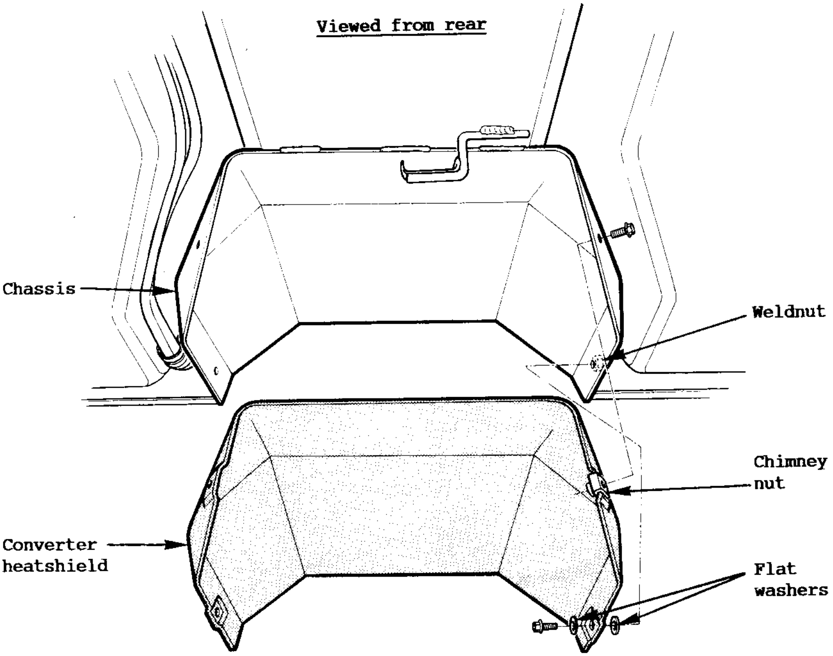
- over the top of the turbocharger;
- in front of the turbo outlet pipe;
- in front of the starter catalyst housing.

In order to avoid fatigue fractures, it is most important that these three shields are assembled correctly, especially where the turbo outlet pipe shield is secured to the other two shields. Refer to the diagram for the correct assembly sequence.


FRONT
Turbocharger heatshield
Pipe heatshield behind catalyst shield
Turbo outlet pipe heatshield
Leg fitted behind turbo shield
Pipe heatshield over catalyst shield
Starter catalyst housing (downpipe) heatshield

Catalytic Converter Heatshield

On cars with catalytic converters, a phenolic resin heatshield is fitted to the chassis above the converter to protect the chassis/body and rear engine mounting from the considerable amount of heat produced by the converter. The shield is secured by four fixings, the rear two using chimney nuts clipped to the shield, and the front two using weldnuts on the chassis.


Viewed from rear
Chassis
Weldnut
Chimney nut
Converter heatshield
Flat washers

# INTERIOR TRIM

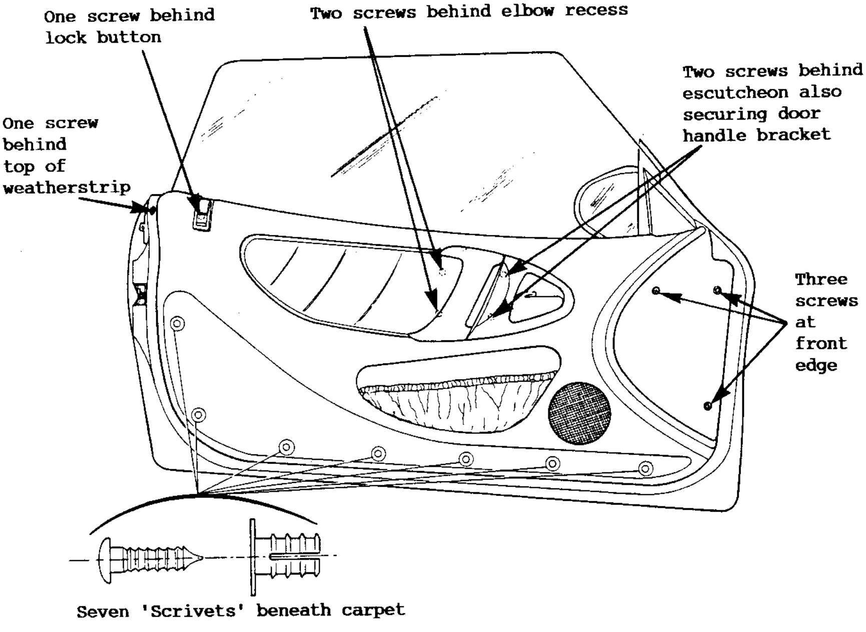
## SECTION VD - ELAN

| | Sub-Section | Page |
|---|---|---|
| Door Trim Panels | VD.1 | 2 |
| Centre Tunnel Console | VD.2 | 3 |
| Instrument/Switch Panel (Fascia Mask) | VD.3 | 4 |
| Main Fascia | VD.4 | 7 |
| Sill Tread Plates | VD.5 | 7 |
| Speaker Boxes | VD.6 | 9 |
| 'B' Post Trim Panels | VD.7 | 11 |
| Capping Rail | VD.8 | 12 |
| Roof Stowage Shelf & Side Panels | VD.9 | 13 |
| Screen Surround Trim Panels | VD.10 | 14 |
| Seats | VD.11 | 15 |
| Seat Belts | VD.12 | 16 |

## VD.1 - DOOR TRIM PANELS

Note that it is almost always necessary to replace the interior lock button retaining clip each time the door trim panel is removed. To remove the panel:

1. Raise the lock button, and prise out the orange clip retaining the button to the lock rod, and withdraw the button. Remove the trim panel retaining screw from the lock button recess.
2. Remove the screw behind the interior release handle, and unhook the handle escutcheon from the trim panel. Via the aperture revealed, remove the two screws securing the release handle bracket and trim panel to the door shell.
3. Lever out the inlay panel from the elbow recess in the door trim panel, and remove the two screws to the rear of the door pull handle.
4. Pull off the self adhesive carpet from the lower part of the trim panel, and unscrew the seven fixings.
5. Carefully use a scalpel to cut the adhesive and enable the the top rear end of the door weatherstrip seal to be pulled down sufficiently to release the single screw securing the rear edge of the trim panel. Release the three screws at the front edge of the panel, and withdraw the panel from the door.


One screw behind lock button
Two screws behind elbow recess
Two screws behind escutcheon also securing door handle bracket
One screw behind top of weatherstrip
Three screws at front edge
Seven 'Scrivets' beneath carpet

To refit the door trim panel, reverse the removal procedure, noting the following points:

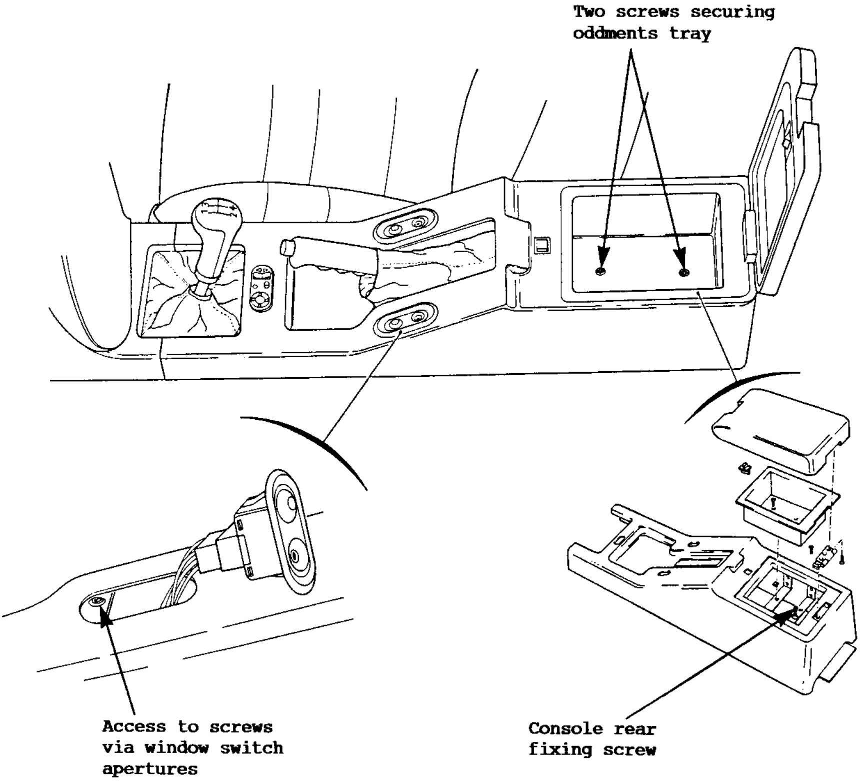
- Fit the top edge of the panel into position, with the door button lock rod through the button aperture. From behind the panel, hold the rod in the fully raised position while the button is fitted and correctly positioned, before pressing the retaining clip fully home.

## VD.2 - CENTRE TUNNEL CONSOLE

To remove:

1. Remove the filler panel between the rear of the tunnel console and the cabin rear wall by pulling upwards from its two fir tree fasteners.

2. Pull out and disconnect the mirror control switch, to the rear of the gear lever.


Two screws securing oddments tray
Access to screws via window switch apertures
Console rear fixing screw

3. Pull out and disconnect the two window switches, each side of the parking brake lever, and release the two console front fixing screws via the switch apertures.

4. Release the two screws securing the oddments tray, and lift out from the rear of the tunnel top. Release the two console rear fixings via the tray aperture.

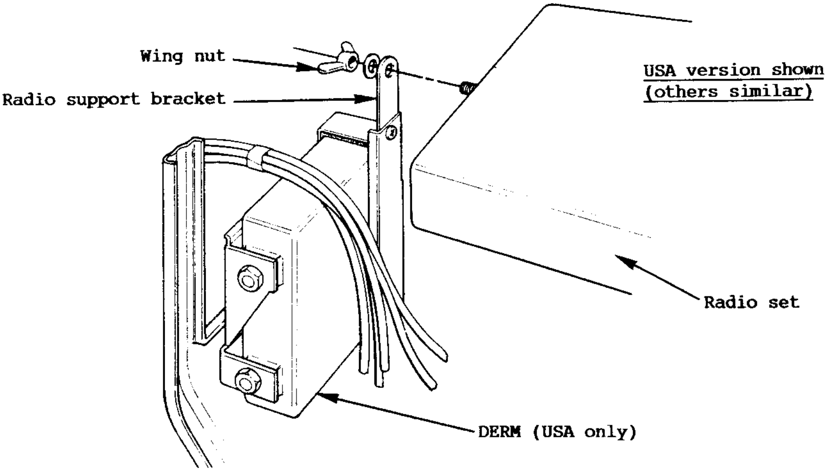
5. Pull the console to the rear to disengage the tongues from the main fascia, and then lift the console over the parking brake lever.

   Replace the console in the reverse order to removal.

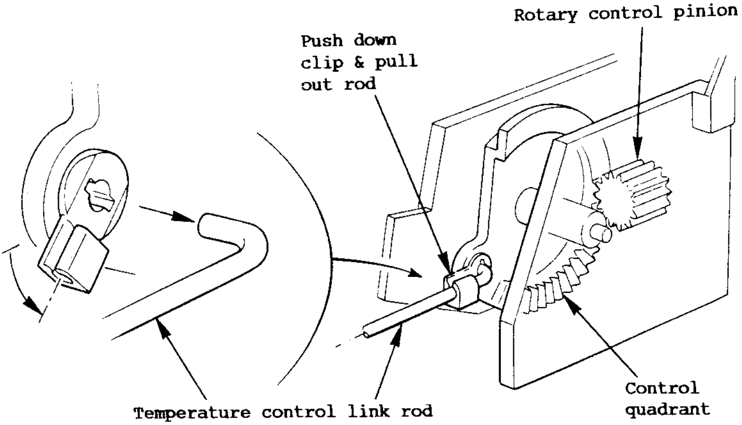
## VD.3 - INSTRUMENT/SWITCH PANEL (FASCIA MASK)

The instrument/switch panel houses the main and auxiliary instruments, switches, climate controls, centre face level vents and I.C.E.. The panel is also known as the fascia mask.

1. Remove the glovebox pivot pins, and glovebox. From the glovebox aperture, reach behind the radio unit and release the wing nut and washer securing the support bracket to the back of the set. Use the release forks to withdraw the radio unit, and disconnect the aerial lead, speaker harnesses, and power and earth leads.



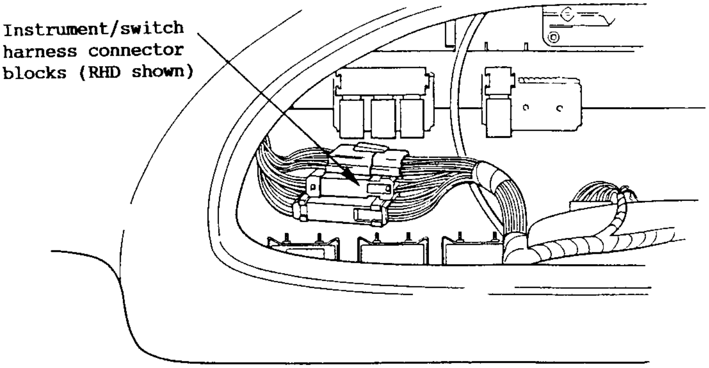
2. Reach behind the climate control panel, and unclip the temperature control link rod from the control quadrant. Also pull off the vacuum pipes connector plug from the rotary distribution control.


Rotary control pinion
Push down clip & pull out rod
Control quadrant
Temperature control link rod

3. Remove the steering wheel: **For USA vehicles fitted with a Supplementary Inflatable Restraint (S.I.R.), see Service Notes Manual WB for precautions and procedure for removing the steering wheel.** On all other vehicles:
   - press the centre horn pad and turn counterclockwise to release from the bayonet type fixing;
   - remove the nut and washer retaining the steering wheel and mark the relative positions of the wheel and inner column to aid refitting;
   - pull the wheel off the column using minimum force. If necessary, use a suitable puller. For improved puller access: remove the foam ring and two socket head screws securing the horn push spring assembly, withdraw the spring assembly and disconnect the horn lead spade terminal.
     **DO NOT** apply excessive axial force to either the inner or outer column without the use of a steering wheel puller, or the mechanism retaining the telescopic length of the collapsible column may be overridden, necessitating column replacement.

4. Remove the column shrouds. Press down the plastic tabs retaining the column switches, and slide the switches from their carrier bracket.

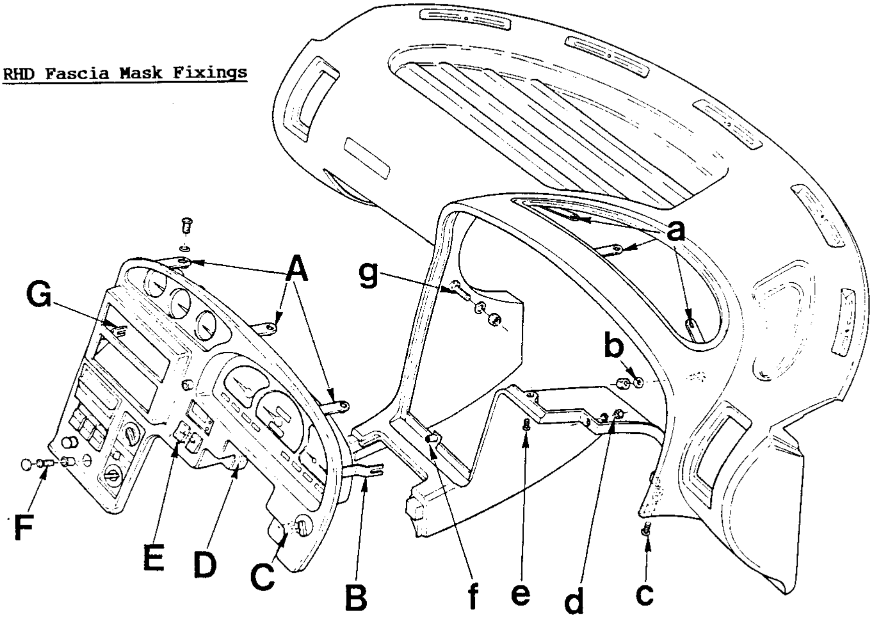
5. Release the two screws, and remove the instrument access panel from the top of the binnacle. Disconnect the speedo cable, and the three instrument/switch harness connector blocks.


Instrument/switch harness connector blocks (RHD shown)

6. RHD cars
   Release the nine fixings securing the fascia mask to the main fascia:

- From within the instrument cluster access aperture, remove the three screws (A), and slacken the single nut (b) securing the top edge of the fascia mask.
- Remove the two blanking plugs in the bottom edge of the driver's side fascia, and release the two fixing screws (c) and (e).
- From the underside of the fascia, release the single fixing nut (d) to the inboard side of the column.
- Remove the blanking plug at the bottom of the fascia mask adjacent to the cigar lighter, and release the lower fixing screw (F).
- From the radio aperture or the glovebox aperture, slacken the fixing at (g), and withdraw the instrument/switch panel from the main fascia.

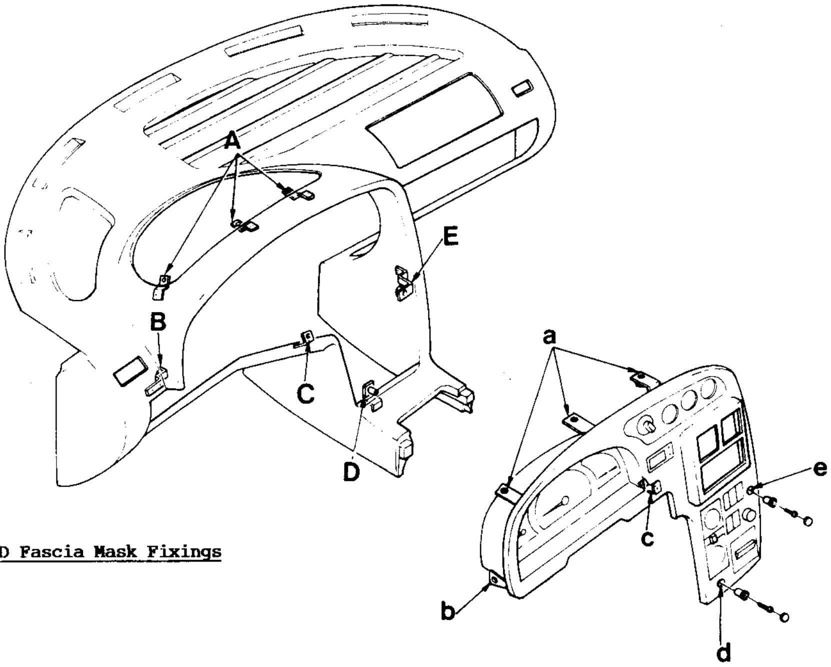
**RHD Fascia Mask Fixings**



LHD cars
Before releasing the fascia mask fixings, it is necessary first to remove the driver's side fascia filler panel (non-SIR cars) or knee bolster (SIR {air bag} cars). The non-SIR type filler panel may be removed after releasing the two screws at the top of the visual face, and pulling the panel upwards. The SIR type knee bolster is removed by releasing the two nuts securing the lower edge of the bolster to the support bracket, and pulling the top edge horizontally rearwards to release the spring clips.

Release the seven fixings securing the fascia mask to the main fascia:

- From within the instrument cluster access aperture, remove the three screws (A) securing the top of the panel.
- Release the single screw fixing (B) from beneath the outboard end of the panel.
- Release the single screw fixing (C) from beneath the inboard end of the instrument panel.
- Remove the two blanking plugs from the fascia mask at the bottom LH corner, and above the cigar lighter, and release the two fixing screws (D) and (E).



**LHD Fascia Mask Fixings**

VD.4 - MAIN FASCIA PANEL

The main fascia panel may, on RHD cars, be removed complete with the instrument/switch panel (fascia mask), after disconnecting the electrics and climate controls, and removing the steering wheel and column switches. On LHD cars, the fascia mask must first be removed to allow access to the fixing at the inboard side of the driver's footwell.

1. Disconnect battery.

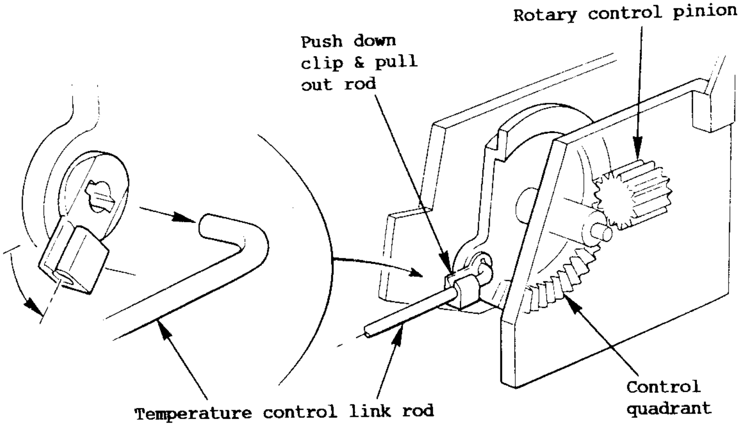
2. Remove the centre tunnel console (see above),,and gear lever gaiter.

3. Remove the steering wheel: **For USA vehicles fitted with a Supplementary Inflatable Restraint (S.I.R.), see Service Notes Manual WB for precautions and procedure for removing the steering wheel.** On all other vehicles:
    - Press the centre horn pad and turn counterclockwise to release from the bayonet type fixing;
    - remove the nut and washer retaining the steering wheel;
    - mark the relative positions of the wheel and inner column to aid refitting;
    - pull the wheel off the column using minimum force. If necessary, use a suitable puller. For improved puller access: remove the foam ring and two socket head screws securing the horn push spring assembly, withdraw the spring assembly and disconnect the horn lead spade terminal.
    **DO NOT** apply excessive axial force to either the inner or outer column without the use of a steering wheel puller, or the mechanism retaining the telescopic length of the collapsible column may be overridden, and necessitate column replacement.

4. Remove the column shrouds. Press down the plastic tabs retaining the column switches, and slide the switches from their carrier bracket.

5. Release the two screws, and remove the instrument access panel from the top of the binnacle. Disconnect the speedo cable and the three instrument/switch harness connector blocks.

6. Loosen the glovebox stop bracket, and allow the glovebox to swing down fully. From the glovebox aperture, reach behind the climate control panel, and unclip the temperature control link rod from the control quadrant. Also pull off the vacuum pipes connector plug from the rotary control.

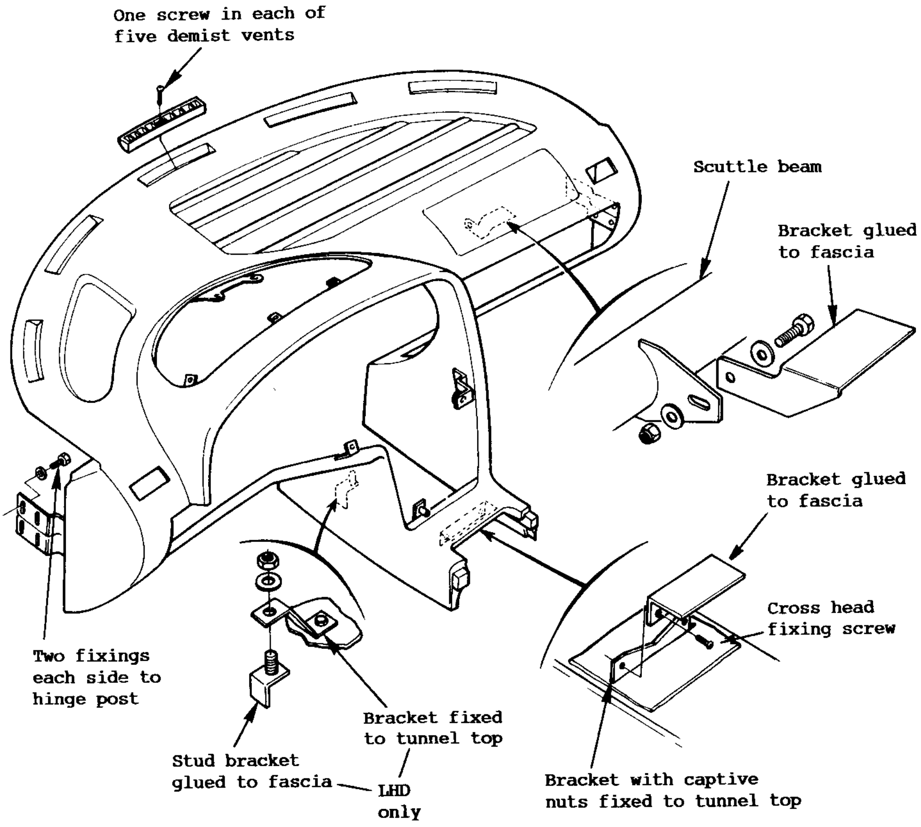


7. Reach behind the radio unit and release the wing nut and washer securing the support bracket to the back of the set, and use release forks to withdraw the radio unit from the switch panel. Disconnect the aerial lead, speaker harnesses, and power and earth leads.

8. Release the ducting to each of the outer face level vents.

9. On LHD cars, remove the instrument/switch panel (see sub-section VD.3).

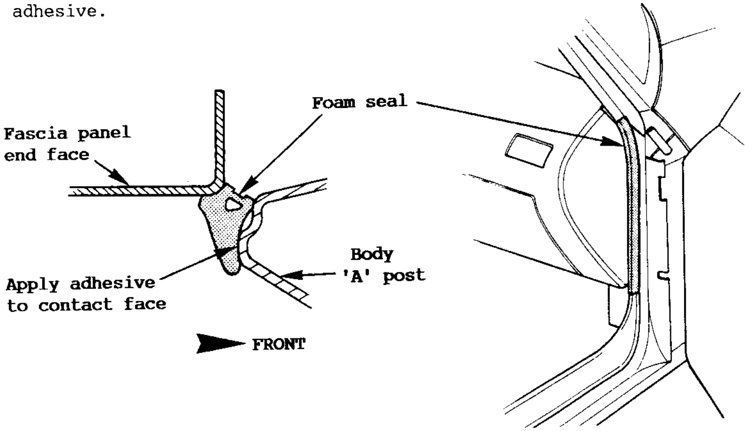
10. Release the fascia panel fixings:
    - one setscrew securing the centre of the fascia to a bracket welded on the scuttle beam, accessible from the glovebox aperture.
    - two screws with fore/aft axes fixing the bottom of the facia to the tunnel top, ahead of the gear lever. These screws are concealed beneath the bottom of the fascia and the tunnel top.
    - two M8 setscrews and washers each side securing the ends of the fascia to the door hinge post.
    - one screw in each of the five screen demister vents, adjacent to the base of the windscreen.
    - on LHD cars, release the nut securing the bracket at the inboard side of the driver's footwell, and press down to release the stud from its tunnel top bracket.


One screw in each of five demist vents
Scuttle beam
Bracket glued to fascia
Bracket glued to fascia
Cross head fixing screw
Two fixings each side to hinge post
Bracket fixed to tunnel top
Stud bracket glued to fascia
LHD only
Bracket with captive nuts fixed to tunnel top

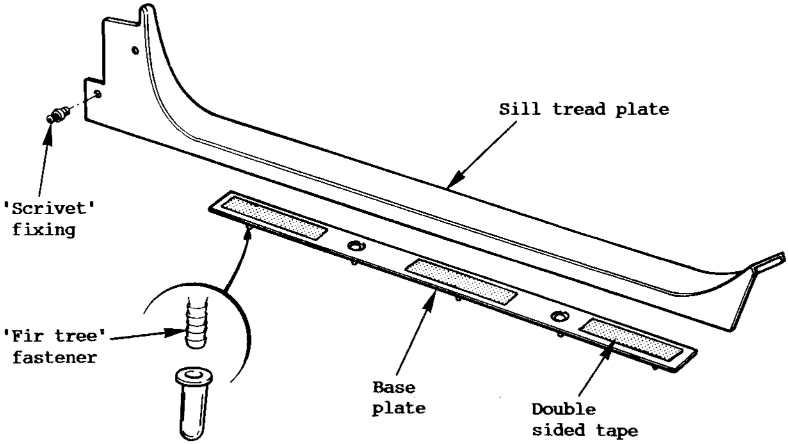
10. Withdraw the main fascia panel over the steering column and gear lever.

To refit the main fascia panel, reverse the removal procedure, noting the following points:

- when refitting the radio, use the access provided by the glovebox aperture to ensure that the spigot on the back of the radio engages with the support bracket fixed to the scuttle brace.
- torque tighten the steering wheel nut to 40 Nm (30 lbf.ft).
- check that the 'A' post to fascia seal is fitted correctly. The neoprene foam seal extends from the bottom of the screen pillar trim panel to the top of the sill tread plate, and is glued to the body 'A' post with Permabond C2 adhesive.


Foam seal
Fascia panel end face
Body 'A' post
Apply adhesive to contact face
FRONT

VD.5 - SILL TREAD PLATES


Sill tread plate
'Scrivet' fixing
'Fir tree' fastener
Base plate
Double sided tape

The sill tread plates are retained in the body sills by five fir tree type fasteners captive in the underside of the tread plates. On the driver's side, an additional two screws secure the front of the panel to the 'A' post. The tread plates may be removed and refitted without disturbing any other trim panel.

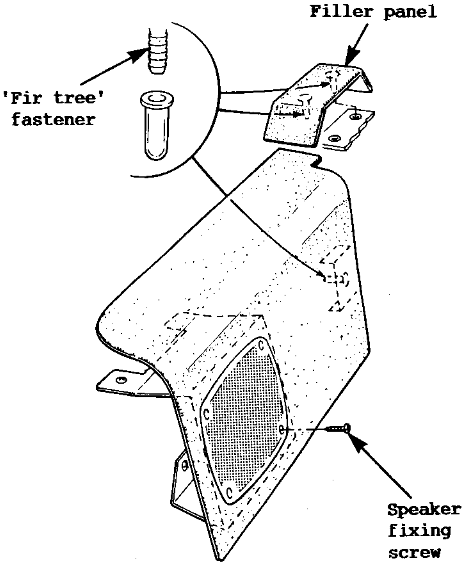
If a new tread plate is to be fitted, note that this will be supplied in two pieces. The base plate with the fir tree fasteners is first fitted to the sill, before double sided tape is applied to the top surface of the base plate. The tread plate is then positioned carefully before pressing down onto the sill to stick to the double sided tape.

## VD.6 - SPEAKER BOXES

The speaker boxes, fitted behind the seats, are retained by the speakers themselves, and a single fir tree fastener.

To remove a speaker box:

- pull out the filler panel behind the centre console;
- release the speaker by removing the four fixing screws securing the speaker, grille and trim panel to the speaker mounting bracket fixed to the body.
- pull the inboard end of the panel forward to release the fir tree fastener, and withdraw the panel.



## VD.7 - 'B' POST TRIM PANELS

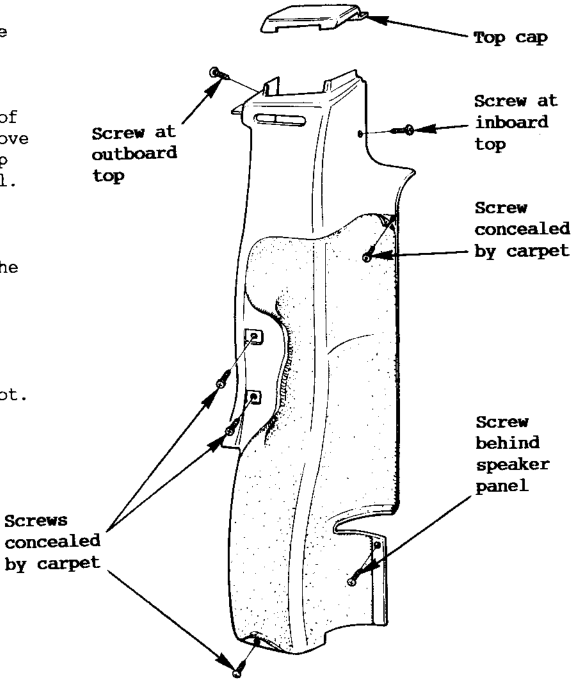
The 'B' post trim panels conceal the seat belt reel and some of the soft top roof mechanism, and are surmounted by a cap which hinges open when the roof is raised. On early cars, this cap was retained by springs, but on later vehicles the cap is hinged at its forward edge to the 'B' post trim panel.

To remove the 'B' post trim panel:

- Remove the sill treadplate (see above);
- Release the seat belt anchorage at the sill;
- Remove the speaker box (see above);
- Peel back the carpet concealing the two trim panel fixing screws along the

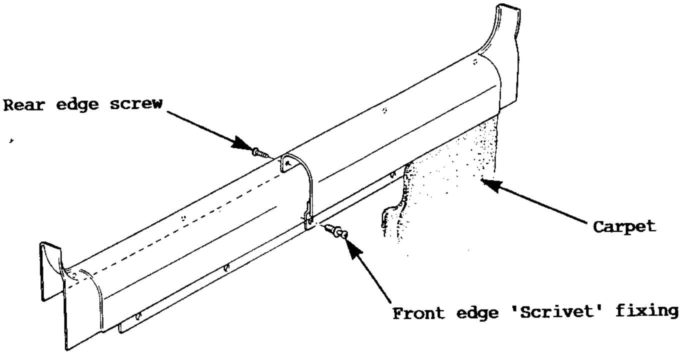
outer edge, and the single fixing at the inboard top corner of the carpet. Remove the three screws.

- Release the end of the roof stowage lid seal, and remove the screw securing the top outboard edge of the panel.
- Remove the screw at the inboard top of the trim panel;
- Remove the screw behind the speaker bracket, and the screw at the bottom edge adjacent to the sill.
- Withdraw the trim panel, feeding the seat belt through the trim panel slot.


Top cap
Screw at outboard top
Screw at inboard top
Screw concealed by carpet
Screw behind speaker panel
Screws concealed by carpet

VD.8 - CAPPING RAIL

The capping rail along the front edge of the roof stowage compartment is secured by screws along its front and rear edges. For access to the 'Scrivet' fixings along the front edge, the rear wall carpet must be pulled down from under the capping rail lip. After removing all the fixing screws, the capping rail may be rolled rearwards and withdrawn without disturbing the 'B' post trim panels.


Rear edge screw
Carpet
Front edge 'Scrivet' fixing

## VD.9 - ROOF STOWAGE SHELF & SIDE PANELS

A separate access panel, retained by four push-in plugs, is incorporated in the shelf to allow ready access to the battery. The roof stowage shelf must be removed for access to the electrical harnesses in the battery compartment, or to the fuel tank.

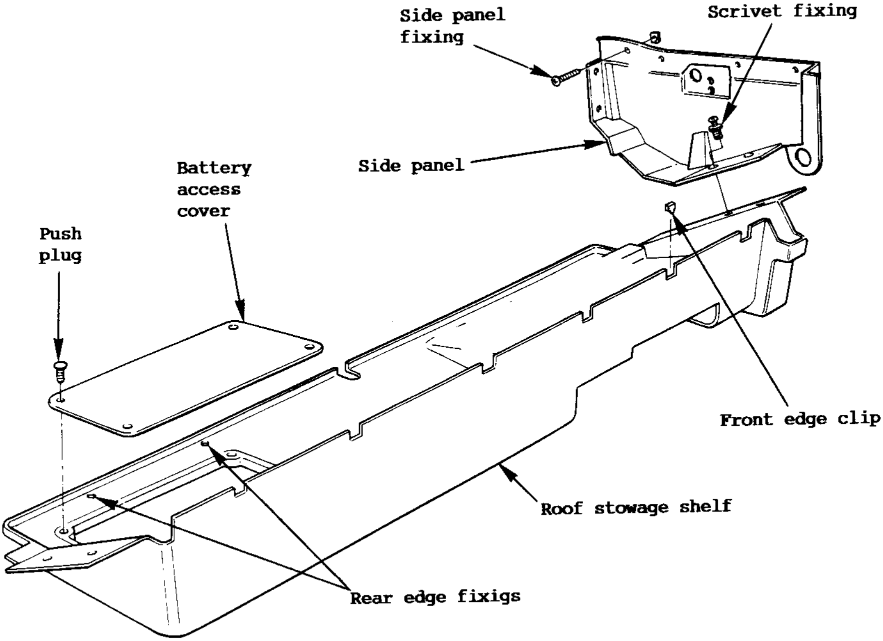
To remove the roof stowage shelf:

- Remove the capping rail (see above);
- Remove the shelf carpet;
- Release the two 'Scrivet' fixings at each side securing the side panels and shelf to the 'B' post reinforcing strut, and the two fixings at the right hand rear edge of the shelf;
- Pull off the clips securing the front edge of the shelf to the cabin rear wall, and withdraw the shelf.

The side panels must be removed for access to the fuel filler neck (left hand side), or on early cars to the roof stowage lid catches.

To remove the side panels:

- Release the two 'Scrivet' fixings at each side securing the side panels and shelf to the 'B' post reinforcing strut;
- Release the screws along the top edge of the side panel, and withdraw the panel.

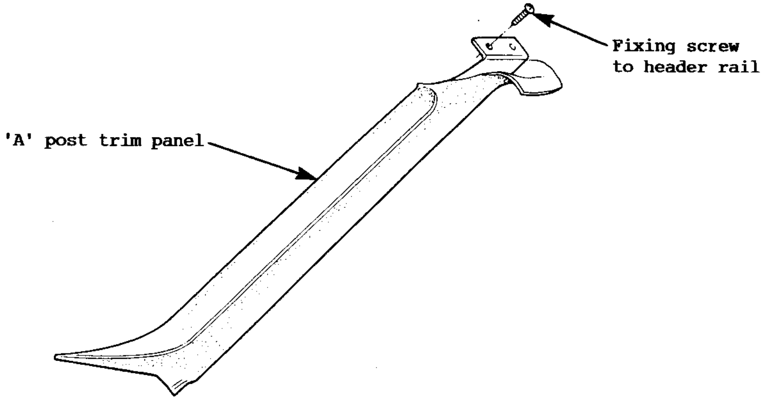

Side panel fixing
Scrivet fixing
Side panel
Battery access cover
Push plug
Front edge clip
Roof stowage shelf
Rear edge fixigs

## VD.10 - SCREEN SURROUND TRIM PANELS

The screen surround trim consists of a header rail trim panel, and two screen pillar trim panels. The two screen pillar trim panels are secured at their lower ends by being sandwiched between the main fascia and the alloy screen pillars, and at the top by screws into the screen pillars.

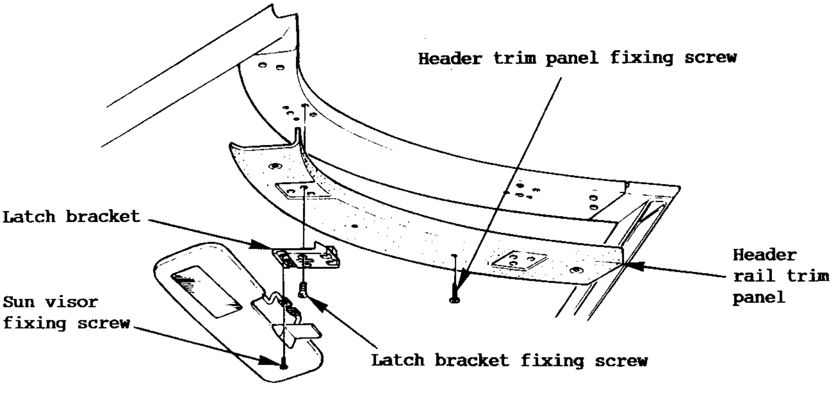
To remove a screen pillar trim panel:

- Peel back the leather trim from the top corner of the screen pillar to reveal the one or two fixing screws. Remove the screws.
- Remove the single fixing screw (if fitted), at the bottom end of the panel, and withdraw the trim panel.


Fixing screw to header rail
'A' post trim panel

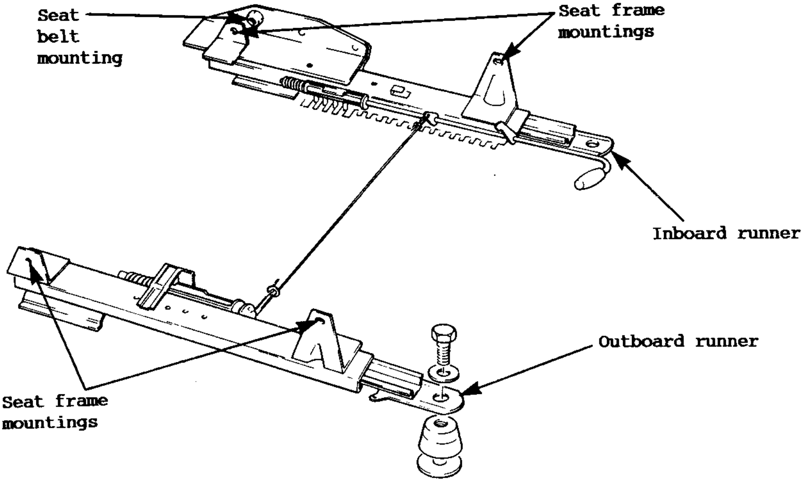
To remove the header rail trim panel:

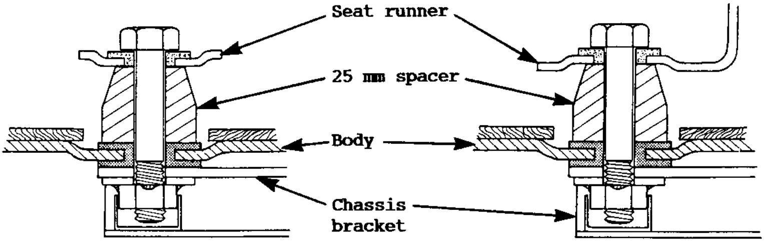
- Pull off the cover concealing the sun visor fixings, and release the two screws securing each sun visor and the three screws securing each roof latch bracket to the header rail;
- Release the top end of one of the screen pillar trim panels;
- Remove the four screws securing the header rail trim panel to the header rail and withdraw the panel.


Header trim panel fixing screw
Latch bracket
Header rail trim panel
Sun visor fixing screw
Latch bracket fixing screw

## VD.11 - SEATS

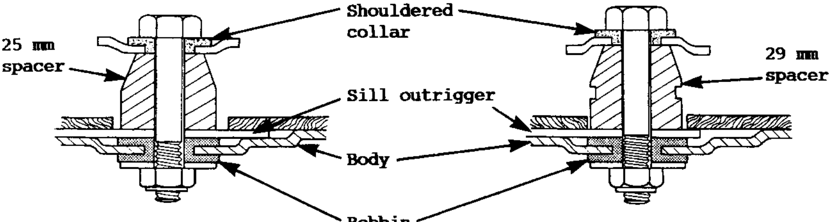
Each seat assembly is mounted on a pair of runners to allow for fore/aft adjustment, with each runner bolted to the floor by two bolts. The inboard runner fixings also serve as body/chassis mountings, and pick up on short outrigger brackets from the side of the chassis backbone. The outboard runners are fixed to the body sill outriggers, with bifurcated aluminium bobbins being used in the body at all seat mounting points.


Seat belt mounting
Seat frame mountings
Inboard runner
Outboard runner
Seat frame mountings


Seat runner
25 mm spacer
Body
Chassis bracket

FRONT INBOARD

REAR INBOARD


25 mm spacer
Shouldered collar
29 mm spacer
Sill outrigger
Body
Bobbin

FRONT OUTBOARD

REAR OUTBOARD

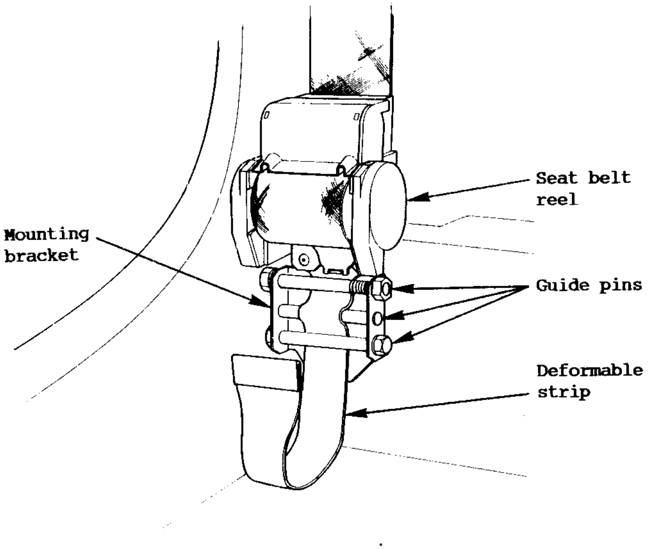
Note that the spacer fitted beneath the rear end of the outboard runner is 29 mm thick, rather than the 25 mm of the other three spacers. Torque tighten all seat runner fixings to 25 Nm (18 lbf.ft).

## VD.12 - SEAT BELTS

The three point fitting inertia reel seat belts are designed to allow the wearer complete freedom of movement under normal driving conditions. The belt reel will lock automatically whenever the vehicle is tilted, or its speed or direction is suddenly changed, as will occur on heavy braking or on impact in a collision. The seat belt anchorage points are as follows:

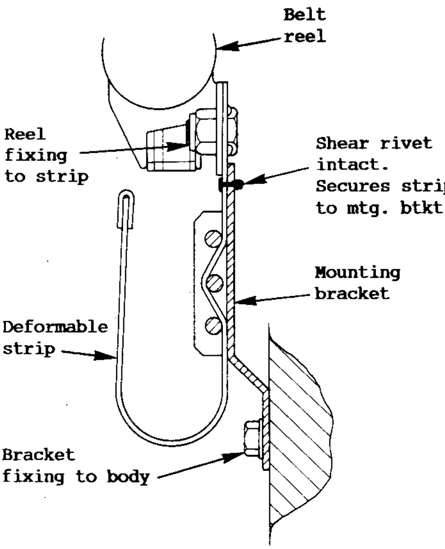
- The belt reel assembly is mounted inboard of the base of the 'B' post by a single fixing bolt.
- The shoulder belt slider is fixed near the top of the 'B' post by two bolts threading into a 'B' post reinforcing strut attached to the 'B' post crossbrace and running rearwards to a spreader plate in the rear wheelarch.
- The outboard end of the lap belt is secured to the sill outrigger.
- The inboard end of the lap belt is fixed to the sliding part of the seat runner, in order that the belt positioning remains correct irrespective of seat position.

On USA cars, a shock absorption system is incorporated at the belt reel mounting, which provides for a controlled movement of the belt reel during a crash if the belt tension exceeds a specified high value. The belt reel assembly is secured to a deformable strip, itself fixed to a mounting bracket by two rivets which are designed to shear under a particular force, applied only when the belt is worn and the vehicle is subject to a severe frontal impact. Movement of the belt reel, and thus 'give' of the belt is then controlled by the rate at

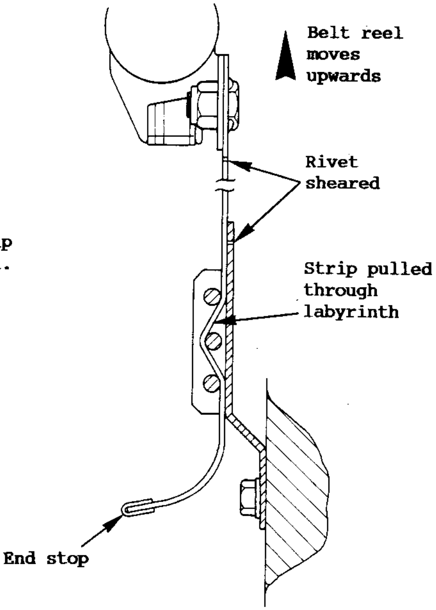


which the deformable steel strip is pulled between three offset guide pins which force the strip to bend in alternate directions. Energy dissipated in this way serves to progressively slow the belt reel and protect the wearer from an injuriously high decelerative force.

**Before Impact**


Belt reel
Reel fixing to strip
Shear rivet intact. Secures strip to mtg. btkt.
Mounting bracket
Deformable strip
Bracket fixing to body

**After Severe Impact**

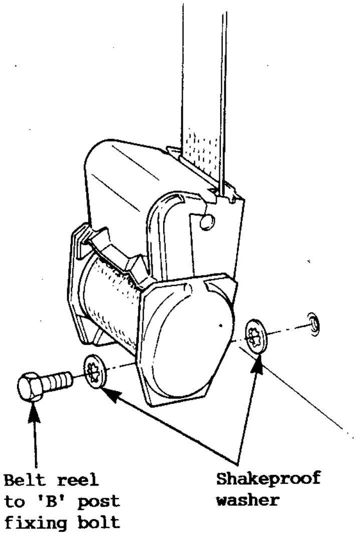

Belt reel moves upwards
Rivet sheared
Strip pulled through labyrinth
End stop

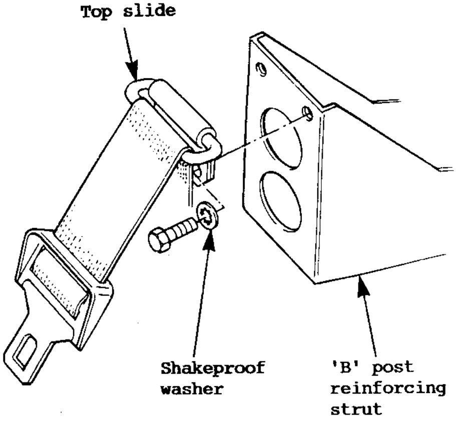
If any seat belt has been worn in a severe frontal collision, the belt should be replaced as a precaution even if there is no visible damage to the assembly. On USA cars, if the rivets securing the deformable strip and belt reel to the mounting bracket are sheared, no attempt should be made to re-rivet the strip, but the strip and mounting bracket should be replaced as a complete assembly.

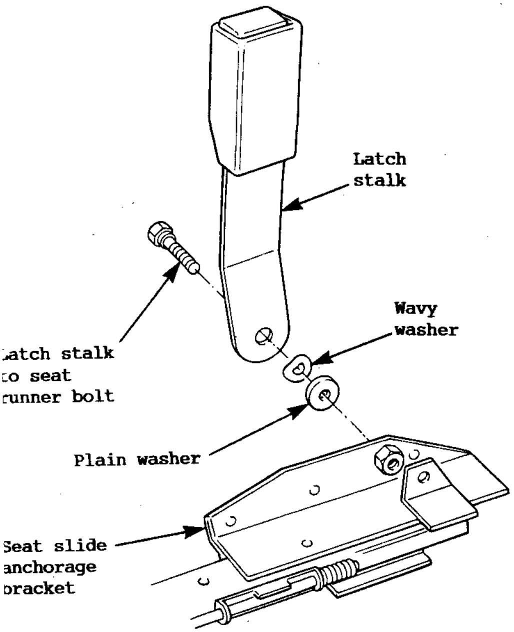
To remove a seat belt assembly, release the seat belt from the sill, remove the 'B' post trim panel (see section VD.6), and release the belt reel assembly and shoulder belt slider from the 'B' post.

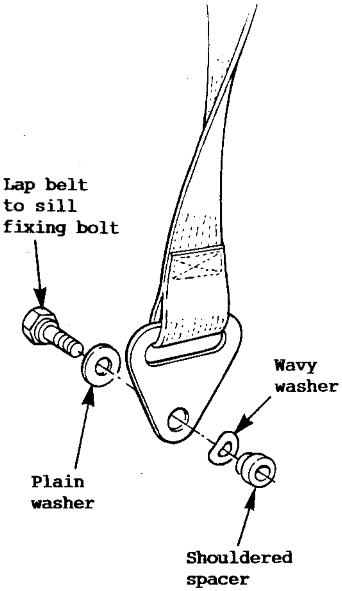
When fitting a seat belt, pay careful attention to the correct assembly of the washers and spacers at each fixing point, as shown in the diagrams. Torque tighten the fixing bolts as follows:

- Belt reel to body (non-USA) or deformable strip (USA): 35 - 40 Nm (26 - 30 lbf.ft).
- Deform strip mounting bracket to body (USA): 35 - 40 Nm (26 - 30 lbf.ft).
- Shoulder belt slider: 43 - 47 Nm (32 - 35 lbf.ft).
- Lap belt to sill: 30 - 35 Nm (22 - 26 lbf.ft).
- Buckle stalk to seat slide: 30 - 35 Nm (22 - 26 lbf.ft).


Belt reel
to 'B' post
fixing bolt
Shakeproof
washer


Top slide
Shakeproof
washer
'B' post
reinforcing
strut


Latch
stalk
Wavy
washer
atch stalk
o seat
unner bolt
Plain washer
Seat slide
anchorage
racket


Lap belt
to sill
fixing bolt
Wavy
washer
Plain
washer
Shouldered
spacer